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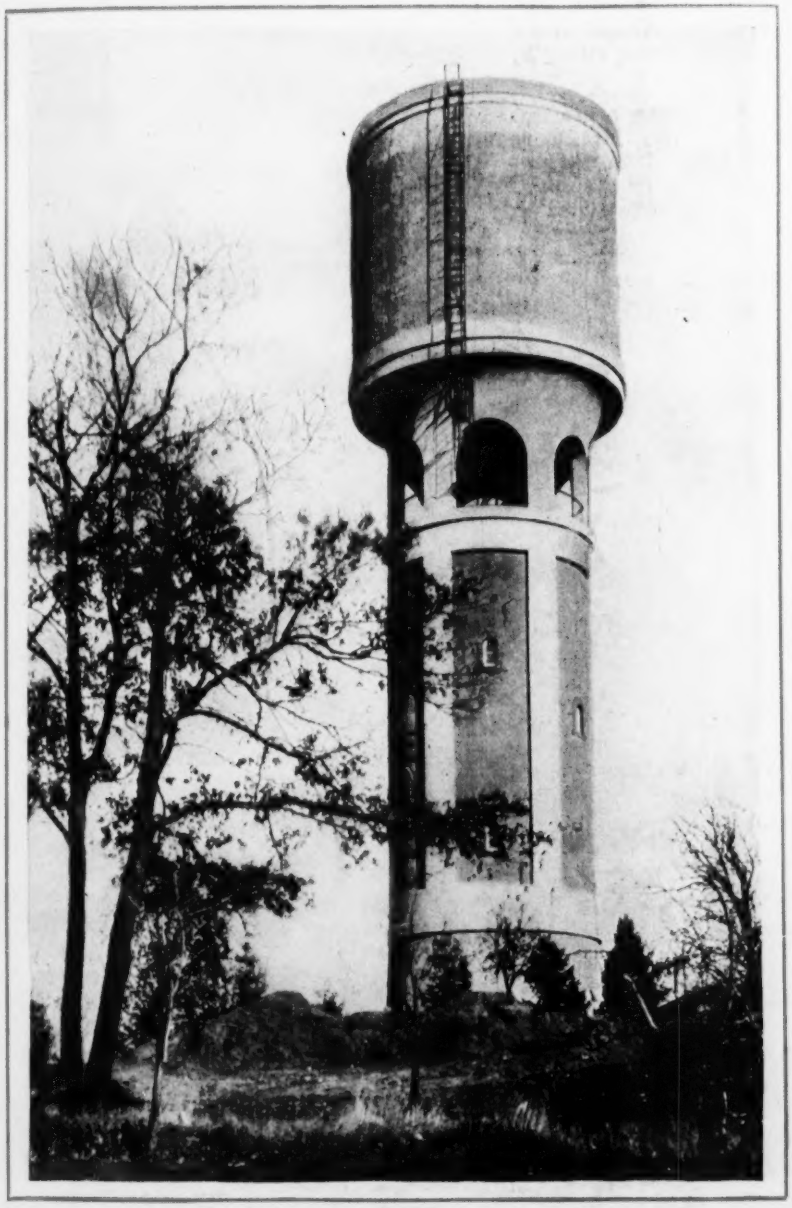
Engineering News-Record



200,000-Gallon Concrete Water Tank
Rochester, Minnesota

August 27, 1925

Difficult Railway Tunneling in Japan

Steel Frame Textile Mill Building at Reading, Pa.

Water-Works Articles In This Issue

Electrically Operated Gages for Filters

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Use of Iodides in Water Supplies

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 95 NEW YORK, AUGUST 27, 1925 Number 9

Paying Europe's Debt

SLOWLY the gentlemen controlling the political destinies of Europe are coming to understand that a debt is something that is to be paid and not merely an indication of past good will. England, in accordance with its tradition, acknowledged this from the beginning. Belgium has now come up to the mark and France, reluctant but persuaded, will soon sit down at a council table here and do what is right and just. The pleasant fiction that the United States alone profited by the war, so popular in speeches and editorials on the continent, falls down before the cold facts of the territorial aggrandizement of every other nation but this on the victorious side of the war. Europe will pay what amounts to the capital of her debts to us; the interest payments will be negligible. Our difficulty is going to be in accustoming ourselves to the necessity of buying from Europe in order that she may get the money to pay. Individuals will be torn between the Scylla of taxation to offset unpaid foreign loans and the Charybdis of competition from abroad in the particular commodity the individual makes in this country. How Congress and the President, representing these individuals, are going to work out the dilemma remains to be seen.

Too Much Economy?

SERIOUSLY to suggest the administration policy of strict economy in federal expenditure falls anywhere short of perfection is to go against the current temper of the American people. But because Mr. Coolidge has so completely "sold" his policy to the public is the more reason why some of its shortcomings should be noted. Secretary Hoover last winter laid down a proper governmental policy when he said that some distinction should be made in favor of constructive over routine federal expenditures. The budget authorities in Washington would probably agree to this distinction but when it comes down to cases they support the routine and deny the constructive. At least they assume certain things have to be done in order merely to keep the machinery going and when those things have been budgeted they have no room for other expenditures that can be justified only because they contribute to future upbuilding. In consequence we find every one of the departments of the government concerned with engineering harnessed, by the economy theory, to routine performance and barred from study or experiment which might conceivably in future bring in return to our citizens a hundred fold. This is poor business in private operations; why is it so lauded in government? Largely because there has been and is extravagance in every government and the ordinary citizen hopes in this latest crusade to see some of this unnecessary spending cut out. It is up to those in the budgeting department of the government, though, to realize how quickly thirftiness ceases to be a virtue, copy books to the contrary notwithstanding, and to use a little more vision in the use of the pruning knife.

How Fast?

PRESUMABLY some engineers will shake their heads at the very thought of exposing a 10-in. water-supply main to low winter temperatures with little or no protection, as was done in providing an additional water supply for Whitehall, N. Y., as described elsewhere in this issue. The pipe is reported as having stood one winter when running only partly full, so why not again? Reliance is placed on velocity to prevent freezing, which is high in this case, as the pipe line drops about 500 ft. in a little over three miles. Who knows how fast the water must move in unprotected pipes to withstand freezing and whether the danger of stoppage lies in successive contractions of the stream through concentric ice layers from the shell inward or from frazil ice or from both?

Tilting at Windmills

WHEN a man as ripe in years and editorial experience as Rossiter Johnson writes and a daily of the character of the *New York Times* publishes without a word of dissent a letter like the one entitled "Why Water Mains Burst and What Was Done in Rochester to Insure Safety," reprinted on p. 340, it is no wonder that the public at large have little true conception of engineering matters. Mr. Little's reply to the letter shows its slight basis of fact and its gross errors of inference for application to conditions of today in New York City or anywhere else. No wonder the public is helpless in combating the real dangers that beset it when its leading citizens and newspapers are so ready to tilt at windmills.

Professional Responsibilities

IN A Western city last spring a large bond issue for water-works improvements failed. There are some recriminations now being indulged in because the local engineering organizations did not back the proposed issue as they did one some years before, which the voters subsequently approved. The reasons why the engineering bodies did not see fit to endorse the later issue are not now pertinent, being involved in local controversy with no general lesson, but the fact is important that the scheme the engineers endorsed was approved and the one they did not endorse, and which some individual engineers condemned, was defeated. Two lessons may be learned from the episode. First, that when the associated engineers of a community once take a definite stand on a public question, their subsequent silence on the same or similar question, especially when the official position is under attack, will be

construed as endorsing the opposition. The second thing to be noted—and it is not a new thing—is that today the public is against any proposal to spend public money. The initial feeling is of opposition and anything that gives weight to the opposition has a double value. In other words, it is easier for a group of engineers to kill a proposed referendum for expenditure on an engineering project by keeping still than it is for them to win its approval by vociferous approbation. Boiled down, then, it will be seen that the responsibilities of the professional engineers of a community are greater than ever before.

A Case for the Psychologist

SOME one out in the University of Chicago ought to take a trip downtown soon and give the denizens of the City Hall a few elementary lectures on psychology. For the gentlemen downtown have evidently not learned yet how unpopular Chicago is in the Great Lakes basin nor how important is some measure of consideration for the possibilities of that unpopularity. The city of Chicago was ordered by the Secretary of War to start this fall on a program of metering its water supply, as a consideration for allowing, for a time, the Sanitary District of Chicago (of which the city is by far the largest part) to take 8,500 sec.-ft. from Lake Michigan. For six months the city has been dawdling over this order and so far has taken no action. The City Council, so a local report says, "does not care anything at all about the order of the Secretary." Meanwhile the Lakes and the St. Lawrence get lower. Sportsmen just back from Canada report natives, who never saw Chicago and probably couldn't locate it on the map, cursing the city for the low water and the lack of fish. Eminent politicians rise in the Canadian parliament and denounce Chicago as the cause of the needed millions to dredge Montreal and Quebec harbors and American press associations circulate dispatches blaming the grounding of pleasure boats in Rochester harbor on the "Chicago Drainage Canal, completed last year." What good is it going to do for Chicago to repeat the acknowledged fact that the canal diversion is responsible only for 5½ in. of lowered lake level and that there has nothing happened in five years at least to change the effect of the canal on levels, when at the same time the Chicago city authorities continue to defy federal orders and take refuge in the purely legal distinction between Chicago and the Sanitary District. Is there no one in Cook County who has traveled along the Great Lakes and listened to people talk? Is there no one there who believes that public opinion is worth bothering about?

Notable Railway Tunneling in Japan

DIFFICULTIES and dangers which are likely to be encountered in heavy rock tunneling are well illustrated in the article on another page by the engineer in charge of construction on the five-mile Tanna Tunnel for the Japanese Government Railways. A still longer rock tunnel, the six-mile Shimizu tunnel, is also under construction, but with headings totaling about 5,400 ft. it has not met with serious difficulties. The description of work on the Tanna Tunnel illustrates not only the difficulties encountered but also the courage and persistence of engineers and workmen in combating these adverse conditions. Rock faults, irruptions of mud, falls of rock and great inrushes of water have all been met, and so far they have all been dealt with successfully, though not without loss of life. For a tunnel length of 25,614 ft., the two headings had advanced a total of 15,337 ft. in April, while 11,684 ft. of double-track tunnel had been completed and lined. Advance borings indicate increasing difficulties, but engineers in general will unite in wishing the Japanese engineers a safe and successful conclusion in this enterprise.

Two Jumps Ahead

THERE is in the eternal regularity and resistless energy of the tides a challenge to man's ingenuity. No one ever stood in a tidal estuary and watched the rush of waters without wondering why before this the natural forces there exhibited had not been bent to man's desire. It is not surprising, therefore, that a scheme to develop power from the Bay of Fundy's restless waters has now gotten enough beyond the dream stage to occasion an attempt to get the State of Maine to amend its stand against exporting power. The proposed plan is magnificent in scope—a possible expenditure of $100,000,000 and a half-million horsepower with dams across tidal rips 200 ft. or more in depth. But the public should be warned. By curious inversion most of us have come to think that to dream largely is to dream well and that only those whose schemes are beyond the power of practical minds are the real prophets of the future. For that reason the Quoddy tidal power gets columns of newspaper space and the interested comment of the man in the street, to whom the latest 300,000 hp. steam power station is the routine performance of routine workmen. And yet the steam station is a real contribution to human progress while the utilization of the tides, in any comparable volume of power, is still a dream with so many complications of hydraulic design and construction detail as to rule it out of immediate consideration. Time will be when man will have to set about gathering in these remote units of natural power, but it is hardly probable that the first step will be the expenditure of a hundred million dollars on one scheme.

Poor Advertising

THE touring automobile is changing more than the Sunday afternoon habits of the people. It is, among other things, advertising a lot of towns and sometimes that advertising is not to their advantage. "What's the matter with Blank," said one man the other day, mentioning an attractive small industrial city in northern New Jersey, "the main street there is on the way up to the mountains and for about a mile through the center of the city you have to drive over the most abominable pavement I ever saw. Haven't they any money or enterprise there? I'd hate to think of starting a new business in a place that would let itself go to seed like that." Ten years ago this same man might have gone through the town in a train and have been so attracted with its sightly location and evident prosperity that he would at least have been favorably disposed to it if in future he had any occasion to consider it for business or industry. By the neglect of its streets now it not only inconveniences its own residents but it sets up an initial barrier to further acquaintance on the part of the thousands of

tourists who curse its bumpy main street. Many of these tourists are just the men the local chamber of commerce appeals to for new developments.

What One Engineer Can Do

FOR years engineers familiar with Niagara Falls have been urging that some structural revision be made at the brink of the falls which will retard their alarming recession and at the same time add to the scenic beauty and increase their utilizable power. In 1920 Col. J. G. Warren, the army engineer officer then stationed at Buffalo, made such a vigorous plea in his classic report on the diversion of water from the Great Lakes; Hugh L. Cooper and the late John Lyall Harper, both long familiar with the falls, have urged some sort of reconstruction of the up-river for years; Isham Randolph as long ago as 1909 had a scheme to correct the inroads of the water and increase its apparent flow. None of these men nor none of these schemes made any great impress on the public mind. About the only thing they did was to arouse the "nature lovers" to a resentment which expressed itself in the cry that the engineers were trying to ruin Niagara. Just to show what one engineer in public life may do, however, it is interesting to watch the progress through the newspapers of the country of a brief press release from Washington which ties up the Niagara revision scheme to Herbert Hoover's name. Secretary Hoover has been disturbed about the destruction of Niagara for a year or two, since he became head of the American St. Lawrence Commission, and he, like every other engineer who has studied Niagara, is convinced that some weir or island or up-river dam will have to be built to keep Niagara from ruining itself and that in that construction there will be the useful byproduct of more utilizable water. Now newspapers who never heard of Col. Warren, Col. Cooper, Mr. Harper, or Mr. Randolph are falling over themselves to emphasize the need of something being done at Niagara. Thus is illustrated one of Mr. Hoover's great contributions to our national progress; that is, the making clear to the public consciousness of a number of engineering necessities which have been locked up in the engineering collective mind and which through the lack of proper publicity by the engineer himself have not got beyond the inner circle of engineering knowledge.

A Many-Sided Water-Works Question

THE many-sidedness of engineering questions is shown by the discussion following the article advocating two water mains in wide streets elsewhere in this issue. Giving due weight to the experiences and comments pro and con, there is a preponderance of evidence in favor of the plan, but subject to numerous modifications to meet local conditions. These modifications work both ways: That is, on the one hand cases are presented where two mains might well be or have been laid on streets of moderate or even rather narrow width, the smaller one in some cases larger than the author proposes, or even a third main is proposed or has been actually laid; while on the other hand, the argument or experience cited is either for making the second pipe of 2-in. wrought iron instead of 4- or 6-in. or cutting it out entirely.

The author labored under the disadvantages of a space limit that necessitated brevity and of holding a brief for the increased use of cast-iron pipe. The combination led him to be sparing of details, to base his cost comparisons on one set of conditions only (street and lot widths, size of cast-iron pipe, size and material of services) and to confine himself, as all brief writing advocates must, to the advantages of a plan which, as many of the commentators show, has strong disadvantages also. And yet, as we have said, the preponderance of the discussion is favorable to the plan, for application under the rule of reason or good engineering judgment based on all the data in each case.

How many are the ramifications of the two-main plan, and how it must be considered jointly with other underground burdens, is illustrated by a correspondent who says there is equal reason for two sewers and two gas mains—and, he might have added, a wire-conduit each side of the street. Another correspondent tells of a start towards just such duplication. The question arises: "How find space for so much duplication, and what will happen at street intersections." These and other questions that might be raised—such as what is to become of trees, shrubbery and hedges under this sort of multiple-duplication already in progress—add further to the growing need for comprehensive city planning.

The two strongest reasons for duplicate conduits, be they for water, sewage, gas or wires, are (1) protection of expensive pavements from continuous cross-trenching, which evil applies only in less degree to narrow as well as wide streets, and (2), chiefly on wide streets, to save the first and maintenance cost of long service connections, which ties in also with pavement damages. We will not repeat the pros and cons of these two lines of argument, presented in the article and discussion, further than to emphasize the fact that several of our correspondents, in expressing opinion and in citing practice, are against the undoubtedly strong current demand for compelling service connections to be laid from the main (when in the street) to the curb before a permanent pavement is put down, or else wait five or even ten years before they can have water from the public mains. The protest and arguments against such compulsion and penalty deserve consideration. And we may add that we should like to see carried to the highest possible court a lawsuit to compel a water connection for a property owner who, let us say, had bought a lot and built a house after some previous owner of unimproved property had declined to put in a service connection prior to the street being paved.

The discussion shows that, on its face, the relative costs of the two plans depends largely upon whether the water consumer or the water-works pays for service connections, although, some urge, the property owner foots the bill sooner or later. If he does there is at least a question as to how soon or late, especially when the water consumer lives in a rented house. In many cities the water rates are not scientifically adjusted to insure any such thing. The problem would be both simplified and clarified if the service pipe—to the curb at least—were made a part of the capital investment of the water-works plant.

As a result of Mr. Wolfe's article and the discussion elicited, we hope that the entire subject of duplicate water mains will be given increased attention, including its bearing upon the need for more comprehensive city planning and a reform, in many cities, of water-works financing methods.

Why Not Two Water Mains in Wide Streets?

A Brief for a Revision of Common Practice

By Thomas F. Wolfe
Research Engineer, Cast Iron Pipe Publicity Bureau, Chicago, Ill.

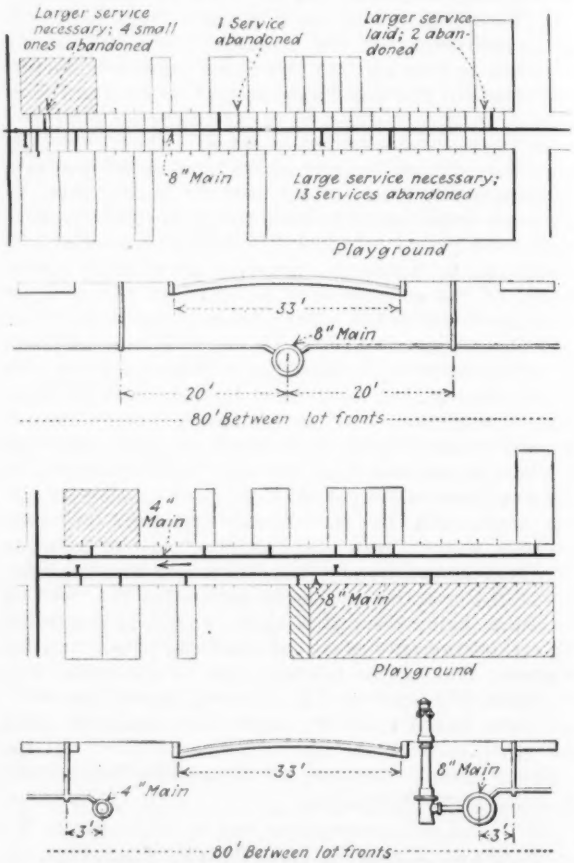
With Comments Pro and Con from Twenty-six Water-Works Engineers and Superintendents

RECENT increased cost of pavements combined with the tendency towards wider streets makes the distribution of water to the fronting property a different problem than heretofore. As street widths increase the old system of laying a single main at or near the center of the street becomes more and more burdensome until the use of two mains become not only cheaper in first cost but also considerably cheaper in cost of maintenance.

In the two-main system here advocated by the writer the pipe on one side of the street would be large enough to provide for the domestic consumption on its side and the fire protection on both sides of the street. The main on the other side would be a smaller one, usually 4 or 6 in. in diameter, depending upon the length of line between connections, and would have no fire hydrants connected to it. These two mains would be cross-connected about every two blocks with valves at each connection. Each of these mains would be laid either some 2 ft. from the lot-line or, where the sidewalks touch the lot-line, the mains might be laid 1 ft. from the outer edge of the walk. With the two-main distribution system, service pipes would be installed only when buildings were being constructed. This would make it possible to install a service pipe of the proper size and at the proper location for each building, and do away with the practice, current in many cities, of installing service pipes for each lot prior to paving. Under the latter plan many services are installed that are never used, and many that are properly located are not large enough to take care of the size of building subsequently constructed, making it necessary to open the pavement in order to install a larger service pipe. This opening is expensive to make, expensive to repair, and usually is a continual nuisance to traffic.

The use of the two-main system eliminates the necessity of any service pipes crossing the street, and puts the mains in parkways where the cost of digging for leaks is relatively slight and the damage to pavements is entirely eliminated. Experience has shown that most of the leaks in distribution systems are either in service pipes, or at the connection of these with the main. Many of these leaks are difficult to locate because of the fact that the water will either escape to a sewer or if it comes to the surface will fail to appear in the vicinity of the leak itself. With the mains in the parkway, both of these difficulties are removed, and the cost of locating and repairing leaks is reduced.

As an example of the relative costs of the two types of installations, we will assume a street 80 ft. wide



ONE-MAIN AND TWO-MAIN WATER DISTRIBUTION SYSTEMS FOR WIDE STREETS

from lot front to lot front, blocks 660 ft. long, pavement 33 ft. wide and lots 25 ft. wide. The comparative costs of main and service installations under each plan are practically identical as the accompanying table shows. As the width of the street increases, the saving in favor of the two-main system also increases.

In both estimates it is assumed that services would be installed for each 25-ft. lot as would be necessary in the case of a single-main system where services are installed prior to paving. As a matter of fact, many buildings would occupy two or more lots, consequently, it would not be necessary in the case of the two-main system to install the 92 services, as only such services would be installed as were necessary to supply the buildings actually built. As a result the original cost

COMPARATIVE COST OF WATER DISTRIBUTION MAIN AND SERVICES FOR ONE-MAIN AND TWO-MAIN SYSTEMS

	Single Main	Two Mains
1,320 ft. of 8-in. pipe at $2.36	$3,115.20	$3,115.20
1,320 ft. of 4-in. pipe at $1.40	.....	1,848.00
2 8-in. valves and valve manhole	170.00	.....
2 8-in. valves and valve boxes	.....	110.00
2 4-in. valves and valve boxes	.....	42.00
92 1-in. taps at $3	276.00	276.00
92 1-in. roundway cocks at $2.50	230.00	230.00
92 shut-off boxes at $2.00	184.00	184.00
1,840 ft. 1-in. extra heavy lead pipe at $0.42 for pipe and $0.75 for labor	2,152.80	.....
272 ft. 1-in. extra heavy lead pipe at $0.42 for pipe and $0.75 for labor	.....	322.92
	$6,128.00	$6,128.12

of the two-main system would be reduced by the amount that would be saved by installing only such services as are actually needed, and the cost of maintenance would be cut down because of fewer services.

Other advantages of the two-main system are the elimination of dead services, a prolific source of trouble, and the added cross-sectional pipe area and fire protection provided by the additional main.

Comments on Mr. Wolfe's Proposal

Advance proofs of Mr. Wolfe's discussion were sent to a number of water-works engineers and superintendents from whose comments the following extracts are taken:

F. A. Barbour, Consulting Engineer, Boston, Mass.—At just what width of street the economical point for two-line construction is found depends on so many conditions that each case is a problem to be separately figured. I have found very few cases where two mains could be justified but undoubtedly such conditions do exist.

Leonard Metcalf, Consulting Engineer, Boston—The two-main plan has several advantages and has been utilized in many water-works systems for individual blocks, and sometimes for several blocks. Its general adoption is not likely.

The argument against cross trenches for service pipe is equally potent for gas and sewer connections, and carried to its logical conclusion, each wide street would have two water mains, two sewers and two gas mains. The difficulties resulting from such construction, while of some consequence, would be less within the blocks than at intersecting streets. If these also were wide and each contained two pipes of each kind the numbers of connections required, including valves, and the complicated conditions at the street intersections, would render the method impractical.

Mr. Wolfe assumes 25-ft. building lots fronting on a wide street, a condition almost never experienced, and that 1-in. lead service pipes are to be laid for each of these lots in advance of paving. In few, if any, cities would so large service pipes be laid when the material is lead, not subject to obstruction through corrosion, and when the lots are as narrow as 25 ft. The omission of allowances for connections with more than one pipe at cross streets and for the necessary additional valves, also vitiates the comparison.

In cities in which the space beneath the streets is nearly all occupied by underground pipes and structures of various kinds, it would usually be impracticable to attempt to find a location for two water mains under the same pressure merely to make a saving in service pipes.

In two or three cases where extensive reinforcements of a distribution system were required we have suggested laying a second pipe on the opposite side of the street from the existing pipe and maintaining both in service, as less costly than substituting a larger one. The trouble and expense of maintaining service while a substitute pipe is being placed is considerable, and in the smaller cities, where the streets are not congested with underground structures, and where little rock is encountered, the reinforcement is much more easily accomplished in this way.

Stephen H. Taylor, Superintendent, Water-Works, New Bedford, Mass.—The plan has many advantages. Connecting services to every property when mains are laid has never been successful here. They usually lie idle for a long time and when needed are wrong either in size or location. Our single mains are laid a third of the way from the property line, the remainder of the space being left for sewer, gas pipes, etc. In wide streets this causes excessive friction loss in the services on the long side. I would not favor even a secondary main as small as 4 in.; 6-in. costs very little more and, if desirable, hydrants can be connected to it as well as to the other main.

C. M. Saville, Manager and Chief Engineer, Water-Works, Hartford, Conn.—Besides the advantages of starting with two mains there is sometimes an advantage in placing a small pipe, say 8-in., on one side of a wide undeveloped street. When the territory has been built up and the street is to be paved a line can be laid on the opposite side, reconnecting the long services to this second main. The difference in cost between the small main first laid and the larger main which would be required if only one main were laid to serve future conditions, will help materially in financing the duplicate main besides making it possible to size the second main according to actual needs. It is also possible by cross-connections and hydrants 500 or 600 ft. apart to give ample fire protection on both sides of the roadway.

It seems that the time limit for laying single mains of large capacity has been about reached, and that in the future both lessened cost and better service will be had by the introduction of two mains, one located on either side of the street for local draft, and a third main of large size, if necessary, laid in the park space. Mains 20 in. and up should not be shut down for service pipe work.

George C. Andrews, Water Commissioner, Buffalo, N. Y.—From an operating man's viewpoint the ability to make service connections as the property is developed and not be compelled to put them all in the street when the pavement is laid, as is necessary with the single-main distribution system, more than counterbalances the possible increase in cost. In Buffalo leaking unused services not only waste large quantities of water but also cause deterioration of the pavement. Unfortunately, Buffalo does not pay for or control the laying of services from the main to the curb, so it has been financially advantageous to the city to lay a single main; but most of the realty developments calling for wide streets with a park strip in the center have two mains, the developer paying for the extra main. We have not in some time laid services for lots as narrow as 25 ft. Even in the lowest-priced subdivisions the lots have averaged close to 35 ft., with a minimum of 32 ft. Practically everyone is now making provision for a driveway. Where the real estate developers have laid the extra main the lots have had a minimum width of 35 feet.

B. C. Little, Superintendent, Water-Works, Rochester, N. Y.—The two-main plan must be limited to streets which promise for some time to be mainly residential. Business blocks or buildings frequently extend their areaways under the sidewalks and out to the curb lines, and the running of public water mains through such cellars is reprehensible, and digging in and out of the streetway proper to avoid them is annoying and costly. I advocate cross-connections at every block instead of every two blocks. At every street intersection there should be a lateral anyway for the crossing street and the cost for the connections would, I think, be offset by the advantage gained, should the district grow very rapidly and need an increased supply on the small-main side of the street; also in case of a break smaller sections would be shut out of water. On extra-wide residential streets—especially with a center parkway—we insist on two mains. When an old main, because of growth of a section into a business district, no longer meets the demands, we have laid a second and larger main on the other side of the street and left the old one in—but our mains are in the roadway.

W. W. Brush, Deputy Chief Engineer, Department of Water Supply, New York City—New York lays two water mains where the street is 100 ft. or more in width. Car-tracks are an additional reason for two mains. Each main is generally large enough for fire as well as domestic service—size 6 rather than 4 inches. We have not been willing to permit services to be installed in advance of use, due to the leakage that occurs when services are installed and not connected—and frequently they are never connected. While in many localities leaks will probably show at the surface, with the rock-filled streets and other subsurface conditions in New York this is not true. The main objections to the two-pipe system are: (1) Proximity of mains to buildings increases the likelihood of flooding, due to a break, and the undermining of the building if the foundation is not carried to sufficient depth to prevent such undermining. (2) Length of mains to be maintained is approximately double, with the attendant number of valves. (3) At street intersections there are two mains in place of one which have to be crossed by other subsurface structures.

D. W. French, Superintendent, Hackensack Water Co., Weehawken, N. J.—For fifteen years and in numerous cases we have laid mains on each side of wide streets—same size on each side. If the road is extra wide and if all of the

fire hydrants are located on one side and a fire occurs on the opposite side, traffic interference is pretty sure.

C. E. Davis, Manager, Philadelphia Suburban Water Co., Philadelphia—While chief of the Philadelphia Bureau of Water I almost succeeded in having an ordinance passed requiring two mains on wide streets. In my present position, I have just approved a double pipe line system on a parkway development in Ardmore.

J. W. Ledoux, Consulting Engineer, Philadelphia—No doubt Mr. Wolfe's plan is correct, but I believe very few water companies or municipalities have adopted it.

J. N. Chester, Consulting Engineer, Pittsburgh, Pa.—In many cities the residential streets are covered with gravel over which a bitumastic covering is rolled. It costs less to cut that than to cut cement walks. Again, in many of our cities there is no parking strip and if there is a cross main every six blocks, that's out of the ordinary. I should not want to run a 4-in. pipe more than four blocks without a cross feeder. Assuming that where fire protection is required no pipe less than 6 in. is laid, and that a 2-in. pipe will supply consumption for one block when feeding only from one side and two blocks when fed in both directions (houses on one side of the street); that wrought-iron galvanized pipe will last 30 to 50 years or as long as some 4-in. pipe lasts where the water tuberculates; that it costs the same to dig a trench for a 4- or 6-in. cast-iron pipe, but that a ditch for a 2-in. wrought-iron pipe can be dug for less than either—then how does the case stand? Mr. Wolfe omits consideration of 2-in. wrought-iron pipe. I think it safe to say that 75 per cent of all the second or smaller pipe he proposes could be 2-in. wrought-iron galvanized pipe. I have always refused the laying of dead services at the expense of either the water department or the water company for the plant must earn on its investment and the revenue comes from customers, so this expense is a burden on the consumer for the benefit of the unimproved lot and, therefore, in my opinion wholly unfair.

V. Bernard Siems, Water Engineer, Baltimore, Md.—We place two mains in 66-ft. streets having car-tracks in the center, and in 80-, 100- and 120-ft. streets, whether there are car-tracks or not. The lot frontages on such highways are from 20 ft. upward. We prefer to locate the water main in the bed of the highway near the curb to avoid having meter boxes in the paved sidewalk. Sufficient distance should also be provided between the main and the fire hydrant to permit the installation of a valve on the hydrant branch.

J. L. Ludlow, Consulting Engineer, Winston-Salem, N. C.—Some years ago in laying out a water system for a Southern city with very wide streets I found two mains less costly than one.

Harry L. Shaver, Commissioner of Public Works, Winston-Salem, N. C.—The plan has been followed on some of our wide residential streets having a center parkway, and also to a limited extent in the business district where it is necessary to make water taps for abutting property on each side of the street every 15 or 20 ft. When I was city engineer of Lynchburg, Va., in 1914, not only water but also sewer and gas pipe were laid on each side of Main St., the principal retail business street.

J. E. Gibson, Manager and Engineer, Water-Works, Charleston, S. C.—Two mains for water supply, and possibly two sanitary sewers, offer many advantages. I fully agree with Mr. Wolfe that two mains are justifiable in 80-ft. streets and in many cases where the distance between building lines does not exceed 60 ft. About four years ago we had occasion to lay a parallel main in boulevard space rather than open up an improved hard surface pavement and lay service pipes across sanitary and storm sewers, gas and electric conduits, and a double-track street railway system, and found the saving to be a material one. This was on Meeting St., 70 ft. wide with double trolley tracks in the center, a storm sewer between, a sanitary sewer on the east side, and gas mains on both sides. Lately there was constructed a sanitary sewer on the west side. On the east side of the street we had our 24-in. main supply line (with fire hydrants). Without a second main it would have been necessary to lay service pipes every 40 ft. across this entire paved area, including the substructures. Rather than do this, we laid a 6-in. main (no hydrants) on the west side in the grass strip, connecting it with intersecting mains at each block.

W. S. Cramer, Chief Engineer Lexington (Ky.) Water Co.—Quite a large section of Lexington has the two-main system. We find it satisfactory except for some trouble in circulation in the smaller mains and the necessity for more frequent flushings on the small main than are required on the larger main. Mains in sub-divisions are paid for by the development company, which is opposed to the increased cost of the two-main system cost of services met by consumer. In several recent developments we have installed one main in the plot between the sidewalk and the curb and have put in the service lines for the opposite side of the street with a pipe pusher. This has been very satisfactory in our rather heavy clay soil. We have put in over 200 services of this type in the past year with only two openings necessary in improved streets, due to striking an obstruction. Where all the cost of mains and services is borne by a water department there can be no question as to the saving made in the two-main installation.

John Chambers, Chief Engineer and Superintendent, Louisville (Ky.) Water Co. (Owned by City)—It has been the general practice in Louisville to use the two-main plan but it is not strictly adhered to now. Fire services will be placed on the larger mains hereafter. Domestic services are seldom attached to the larger mains but this has been done where the consumption is large. Most of our streets are 60 ft. wide, although in newer subdivisions the width is 50 ft. The distance between curbs is 36 ft. in the old part of the city, 30 in newer portions. Several 60- to 70-ft. streets traverse the entire length of the city. Service connections from the street mains to the property lines are paid for by the company. I doubt the wisdom of this but it is generally understood that it is required by the company's charter. Under a city ordinance property owners (on notice) are required to make service connections when streets are being constructed or reconstructed, or else defer them for five years, which is the street guarantee period.

George Reyer, Superintendent, Water-Works, Nashville, Tenn.—Mr. Wolfe's assumption that where services are installed before paving they should be placed every 25 ft. should not be accepted, as 25-ft. lots are found only in congested districts. In Nashville, services are installed for each 50-ft. lot, which is quite satisfactory. Using Mr. Wolfe's estimates for each 50 instead of each 25 ft. would show the single-main system to cost $1,076 less than the double. If fire services should ever be required on the side opposite the large main, it would be necessary, with the two-main plan, to cross the entire street, while with a single main in the center of the street, the opening would be only half the width of the street. In using the two-main system, instead of cross-connecting at every two blocks, as suggested, would it not be more efficient to cross-connect at each fire hydrant?

John Ericson, City Engineer, Chicago, Ill.—The method advocated by Mr. Wolfe has been in vogue in Chicago about fifteen years, and was inaugurated before Mr. Wolfe resigned his position in this bureau. Two mains are laid in streets having car lines and in residence streets 80 ft. or more in width. In residence streets 80 ft. wide with 25-ft. lots the cost of laying the two-main system, using a 6- and an 8-in. pipe, is about the same as the cost of laying one 8-in. pipe and lead services to supply the lots. Where a street 80 ft. wide has lots wider than 25 ft. it costs less to lay one main and service pipe stubs than to use the two-main system. In such streets it has been the recent practice in Chicago to lay one 8-in. main 2 ft. within the curb line in the parking space, thus bringing all taps and wipe joints within the parking space and making them accessible for repairs without going through the pavement. With this plan strong lead pipe is the only pipe beneath the pavement, and such pipes seldom spring leaks. Where we lay two mains, the size of the mains is determined by the fire protection and other demands. In car-line or busy downtown streets we place hydrants on both sides of the street.

About three years ago Michigan Boulevard from Roosevelt Road to 33rd St. was double mained (two 8-in.) so that it is now possible to make repairs to these mains or to the service pipes leading from them without interfering with

automobile traffic. Many other streets have been similarly treated during the past fifteen years, a few of which are: Western Ave. for practically its entire length, about 24 miles; 79th Street from Racine Ave. to Western Ave.; Ashland Ave. where it has been recently widened; Madison St. from Hamlin Ave. to west city limits, 2¾ miles; Clark St., now being double mained where widening is going on.

Paul Hansen, Hydraulic and Sanitary Engineer, Chicago, Ill.—In large cities space for water mains is not always available under sidewalks. Usually the cellars of buildings extend out to the curb line. In relatively new developments, however, it would be feasible to reserve a space just inside of the curb line for service conduits. This space might be covered with paving slabs, easily removable, or might be parked—but such conduits interfere with tree planting. Another thing to be kept in mind is that, especially in large cities, it is nearly if not quite as difficult to dig through sidewalks as through roadway paving. Moreover, where the sidewalks are covered with paving there is no greater advantage in locating water mains under the sidewalks instead of under the middle of the street in so far as the detection of leaks is concerned. On the kind of street described, the lots are apt to be more nearly 50 ft. than 25 ft., in which case the cost of the service pipes would be reduced $1,000 for the single-main arrangement, thereby making the cost of the two-main arrangement cost $1,000 more per block.

Charles S. Denman, General Manager Water-Works, Des Moines, Iowa.—Two mains on a wide street increase the capital expenditure and add considerably to maintenance costs and leakage. Here, where the services are paid for by the property-owner the two-main plan would benefit him at the cost of the city.

J. A. Jensen, Engineer of Water-Works, Minneapolis, Minn.—Economic requisites for two water mains in the same street are: (1) Sufficient street width to offer a basis of saving for the second main. (2) Parking strips for the maintenance of boxes and service pipes. (3) Enough lots in the block to make possible the elimination of a sufficient number of "to curb only" services when the block is fully built up. In Minneapolis dual mains have been laid in a few 200-ft. streets, with two roadways in which the mains are laid. Most of the lot frontages are 44 and 50 feet.

E. E. Wall, Director of Public Utilities, St. Louis, Mo.—We have laid two water mains on 100- to 120-ft. streets with no lots less than 50-ft. frontage and many with 75- and 100-ft. frontages. We have one or two streets more than 100 ft. wide in which there was originally laid a 4-in. main back of each curb, but later it was necessary to lay a third main down the center of the street for fire protection. A single main has been laid back of one curb under three varying conditions, with average lot frontages as follows: With a park on one side of the street, 40 ft.; reinforced-concrete pavement, 35 ft.; desire of property owners to have water main on one side and gas main on other side of street, 75 ft. In these cases of services extending across the entire street we have specified the sizes of taps and services and have required clauses to that effect to be put in deeds.

In St. Louis the property owner pays for and owns the service pipe from the water main to his building. He is responsible for its maintenance and also for its renewal if it becomes too small or is damaged by electrolysis or corrosion. The general rule is that the water mains shall be laid north or west of the center line of the street and the gas mains on the east and south. For a long time the gas company installed services at its own expense but for some years past the owner has been charged with the cost and maintenance of the service pipe; therefore to the individual owner the cost of water and gas services would be balanced, no matter where the mains were located, if only one of each was on the street. Whether the city or gas company owns and pays for the services or forces the owners to pay for them makes little difference in the end, as the annual cost to the city or company must be met in the rates assessed, and the consumer pays either directly or indirectly.

To place two water and two gas mains behind the curb on every wide street would require rather nice adjustment of their relative positions, to avoid interference with connections to either main. Then there is the question of avoiding sewer inlets, which must be just at or back of the curb line. In residence districts where trees are regularly planted between the sidewalk and the curb, as is customary here, making connections to the mains or repairing leaks would in most cases cause more damage and annoyance to the owners than if the street were dug up. Here, where the cost of services is borne by the owner, the installation of two water mains on wide streets would greatly increase the cost of the distribution system to the city and would add considerably to the annual charges for operation and maintenance, without materially benefiting the consumer.

We install no service connections except when and where buildings are erected. The bugaboo of spoiling a pavement by cutting holes in it for water or gas connections is held up mainly because in most cities these excavations are temporarily repaired and left in a more or less unsafe condition for weeks or months, on the theory that through the good offices of nature and the beneficent effect of traffic, in time the earth will revert to its normal condition, when the concrete foundation can be placed with the hopeful expectation that it will not settle, and the wearing surface can be laid perfectly smooth and even with the original pavement—things which rarely, if ever, happen. Under proper supervision of backfilling and tamping, and with a competent repair crew, there is no reason why an excavation cannot be refilled, concreted and paved over as good as new, certainly within 48 hours after the work is done for which the excavation was made.

As for locating leaks in water mains more easily when the main is laid behind the curb, this seems to me to be questionable, for now that we have the pitometer, the aquaphone and the geophone, it is not necessary to wait for leaks to appear on the surface. Following are the number of leaks reported by inspectors in the St. Louis Water Division during 1924-25: At leaking joints in mains, 247; at taps, 90; in service pipes, 128. With 130,000 services in use on some 1,050 miles of mains, this number of leaks requiring excavations in streets is not formidable.

N. T. Veatch, Jr., Consulting Engineer, Kansas City, Mo.—The main feature of distribution system design is the proper carrying capacities for fire protection. The plan suggested undoubtedly has merit for business districts where the number of services is large; but I believe that in residence districts, where the services are fewer, and where it is possible to locate them with the necessary degree of accuracy, it would be cheaper and better to put the money all in one main which, on the basis of Mr. Wolfe's estimates, would allow a somewhat larger main to be used.

Robert J. Harding, lately Vice-President and General Manager, San Antonio (Tex.) Water Supply Co.—The plan has many desirable features. In the business district the mains would probably have to be placed very near the curb to permit the use of the space under the sidewalks for basements. This brings up a number of objections, that perhaps weaken the case of double mains in business districts. The residential district is ideal for double mains and can be used either when the fire mains cross the header side of the blocks or when they pass the stretcher side. Fire mains passing the header side with 2-in. mains under each sidewalk on the stretcher side make a serviceable arrangement.

William Mulholland, Chief Engineer Water-Works, Los Angeles, Calif.—Under some conditions the installation of the two-main system is the most economical, such as two wide boulevards separated by parking, or surface-car lines with private right-of-way, but the mains should be laid in the street. The laying of mains within the parkway has many disadvantages, chief of which is that it prevents the planting of trees and shrubbery. It also overloads the parkway, for in many district will be found ornamental street lights, conduits, power and telephone poles, water meter boxes and fire hydrants. Two mains save little or nothing in first cost for with them the use of trenching machines would be limited and in business districts there would be sidewalk cutting. Our method of installing service pipes prior to paving is to run a 2-in. cast-iron pipe to every second lot line.

Alex. Milne, Superintendent Water-Works, St. Catherines, Ont.—I adopted the two-main plan here some twenty years ago on several wide streets then being paved, with approximately the same economic results as claimed by Mr. Wolfe. I expect to use the plan in a new street with double driveways and central boulevard which is to be paved this year.

Difficulties in Long Tunnel for Japanese Railways

Five-Mile Tanna Tunnel Meets Rock Faults—Heavy Water Flow Requires Separate Drain Tunnel—Progress Record

By K. Kusuda
Chief, Atami Line Construction Office, Japanese Government Railways

SERIOUS difficulties in the way of rock faults, earth pressures and great inrushes of water have been encountered in driving the five-mile Tanna tunnel on the cutoff line between Kozu and Numazu, 30.2 miles, which is being built by the Japanese Government Railways on the Tokkaido main line. On this cutoff or short cut, sections have been opened to traffic as the work was finished, and on March 25, 1925, the line was open to traffic as far as Atami, 16.70 miles from Kozu. On the completed portion the longest tunnel is the Izumigoe tunnel, 8,000 ft., which is very near the east end of the Tanna tunnel.

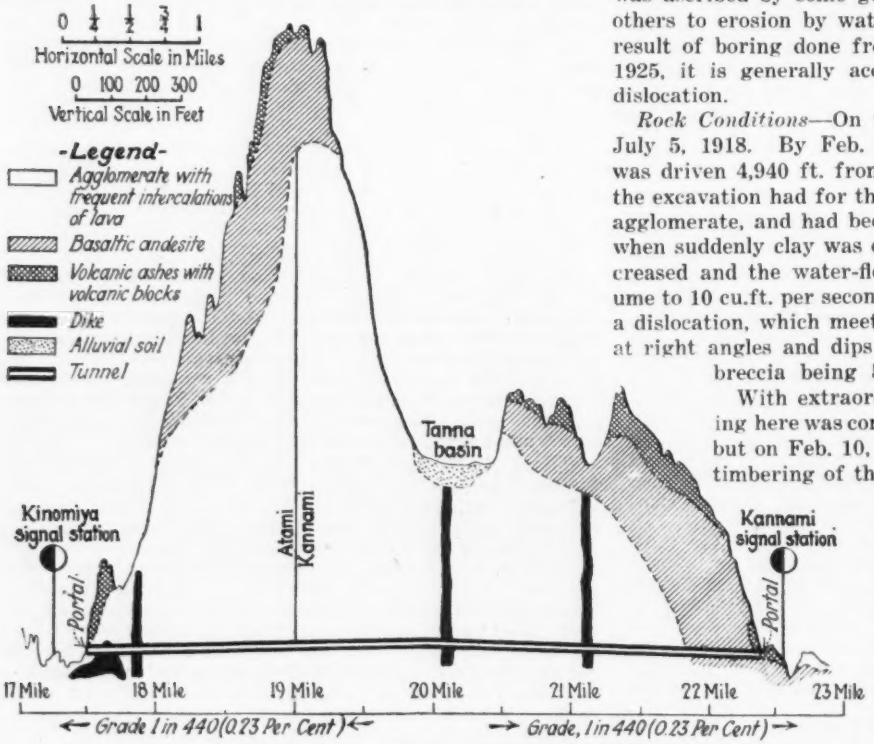


FIG. 1—PROFILE OF FIVE-MILE TANNA TUNNEL; JAPAN
Reproduced from *Engineering News-Record*, March 9, 1922.

Progress Record—The Tanna tunnel, for a double-track line of 3 ft. 6 in. gage, will be 25,614 ft. in length, as described in *Engineering News-Record* of March 9, 1922, p. 394, and April 13, 1924, p. 559. On April 22, 1925, the progress was as follows:

	Ft.
Heading from west portal	7,006
Heading from east portal	8,631
Side walls from west portal	4,818
Side walls from east portal	7,014
Arch ring, from west portal	4,768
Arch ring, from east portal	6,916

The great earthquake of Sept. 1, 1923, the tectonic line encountered in excavation, financial conditions, accidents and other happenings have made the work very difficult and entailed slow progress. During 1924, the average progress of bottom heading on the east side was 7 ft. per day and 210 ft. per month, while that on the west was 4.1 ft. per day and 123 ft. per month.

Excavation has been done generally on the bottom-heading system, but other methods have also been adopted as conditions required. In the general method, after the bottom heading is driven a raise is stoped out at a point about 7 chains from the end of the bottom heading, and from this raise the top heading is driven in both directions; widening to full section completes the excavation. So far, the advance has been through andesite, agglomerate and tuff, and dislocations have been encountered at several spots. A mystery to geologists is how the so-called Tanna Bonchi (Tanna Basin) was created, which lies as a depression in the mountains and above the middle of the Tanna Tunnel. This basin was ascribed by some geologists to dislocation and by others to erosion by water or volcanic action. As the result of boring done from March, 1924, to February, 1925, it is generally accepted that it was caused by dislocation.

Rock Conditions—On the west side, work began on July 5, 1918. By Feb. 16, 1922, the bottom heading was driven 4,940 ft. from the portal. Up to that time the excavation had for the most part been done through agglomerate, and had been carried on rather smoothly, when suddenly clay was encountered, earth-pressure increased and the water-flow also suddenly grew in volume to 10 cu.ft. per second. Here most undoubtedly lies a dislocation, which meets the center-line of the tunnel at right angles and dips eastward 80 deg., its friction breccia being 50 ft. in thickness.

With extraordinary effort the bottom heading here was completely driven on Jan. 19, 1924, but on Feb. 10, during the repair work on the timbering of the heading, about 129,600 cu.ft. of mud suddenly flowed out and the bottom heading, driven at such pains, was filled with mud. Another heading was driven around the slip, but the excavation of this part remains uncompleted. Since then, the bottom heading has been driven further and it is now about 7,000 ft. from the portal. The uncompleted drift or auxiliary tunnel around the slip, shown in Fig. 2 (Dec. 2, 1924), has heavy steel timbering in advance of the concrete lining, while a drain under the track provides for a large flow of water.

On the east side, work has been carried on since April 1, 1918, with the heading now driven 8,626 ft. from the east portal. On Nov. 3, 1924, when the bottom heading had reached 8,200 ft. from the portal, a dislocation of nearly the same nature as that on the west was encountered. It meets the center line of the tunnel approximately at right angles and dips westward 70 deg., the friction breccia of the dislocation being about 40 ft. in thickness. The excavation of this part at the dislocation was postponed, while two temporary drifts, starting from a point just before the dislocation, have been excavated around the dislocated part on the right and left sides respectively.

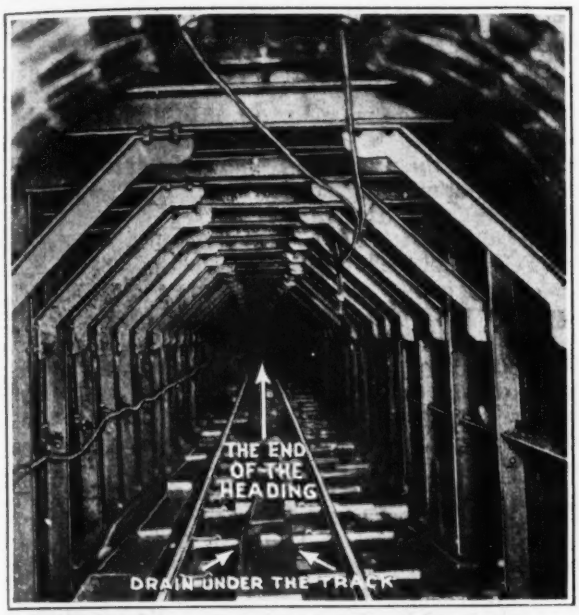


FIG. 2—DRIFT TUNNEL AROUND ROCK FAULT
Note concrete lining, steel timbering and large drain under the track.

Naturally, the dislocation could not be avoided even by these temporary drifts. The drift on the left side, when excavated up to the dislocation, suffered a great earth-pressure and a heavy water-flow of 2 cu.ft. per second which necessitated total abandonment of the excavation. The excavation on the right side could be continued, though with great difficulty, its length being 332.6 ft. At present the bottom heading is being driven again along the former center line of tunnel.

Hardly had the excavation beyond the dislocation begun through agglomerate, when suddenly at about 8,520 ft. from the portal another soft clayey bed appeared. At the present end of heading, 8,626 ft. from the portal, this soft bed is still exposed and the great earth pressure there necessitates very strong timbering, entailing many troubles and tardy progress. Fortunately, too much water-gush has so far not been experienced and the work has been carried on, though slowly. But if the water increases much hereafter, the work will become more difficult. Here the water-flow at present is 0.5 cu.ft. per second.

FIG. 3—A WET TUNNEL HEADING

Heavy Inflow of Water—In the west side bottom heading, since the dislocation was encountered 4,950 ft. from the portal, no small quantity of water has heretofore been flowing, as indicated by the following record:

Date	Bottom Heading, Ft.	Volume of Water Cu.Ft. per Sec.
Aug. 1, 1924	5,860	23.7
Nov. 27, 1924	6,412	28.8
April 20, 1925	7,000	42.5
May 8, 1925	7,080	121.0

Fig. 3 shows the bottom heading at 6,633 ft. from the west portal (Jan. 23, 1925), with streams of water entering from all directions.

At 3:30 a.m. of May 8, 1925, when the rock at the end of the bottom heading, 7,080 ft. from the west portal, was blasted, a great quantity of water flowed out. At 6 a.m., 73.3 cu.ft. per second was recorded, so that the workers were obliged to get away from the work. At 10 p.m. the maximum quantity of flow of 121 cu.ft. was reached, and as the total water-flow in this heading had up to that time been 40.5 cu.ft. the increase was 80.5 cu.ft. Since then arrangements have been made for drainage. At 6 a.m. on May 29, that is, 21 days after the heaviest gush of water, the flow fell to 77.3 cu.ft. and further decrease was expected.

It is very difficult to check such a great flow of water.

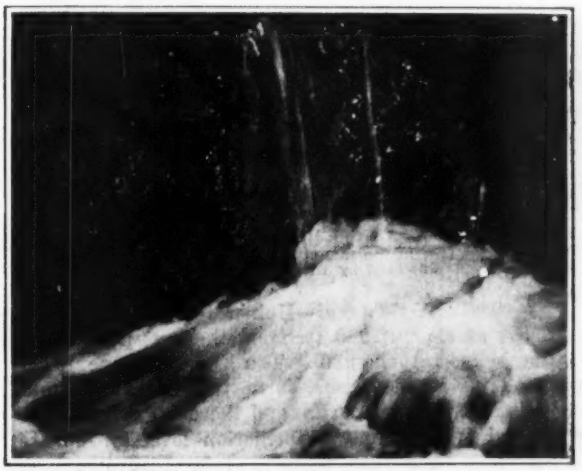


FIG. 4—BIG SPOUT OF WATER IN TUNNEL
Note other streams from roof.

Before the dislocation was encountered, drainage of water inside the tunnel on the west side was provided for by a drain 3 ft. in width and 2 ft. in depth built below the formation level along the center line of the tunnel. But since then, on account of the incessant great flow, another drain, 3 ft. 6 in. wide and 2 ft. 9 in. deep, has been built just under the track on the left of the former drain. In addition, the floor of the auxiliary tunnel around the dislocation was excavated to a depth of 4 ft. from the formation level to form a large drain. The heading was roofed with galvanized sheet iron, so that the workers might be exposed as little as possible to the streams of water.

Since Nov. 16, 1924, when this drain was completed, the water flowing from the end of the auxiliary tunnel has been led into this drain, so that the water there has been successfully drained. But from this point on to the end of the main bottom heading, the water level

still remains nearly knee deep; at one point a number of flows meet at a large spout-hole, about 6,316 ft. from the portal, amounting to a total flow of 15 cu.ft. per second. This great spout is shown in Fig. 4. On the east side, the total inflow of water is now 13 cu.ft. per second.

Drainage Tunnel—Judging from the results of boring done at the Tanna basin last year, the water both on the west and east sides will increase as the work goes on; the basin being just above the middle of the tunnel line in the unexcavated section. For this reason, a drain tunnel having its bottom surface 5 ft. lower than the formation level of the main tunnel, is being built about 40 ft. from the main tunnel on the west side. This tunnel, which is to run parallel to and to be as long as the main tunnel, has inside dimensions of 6x6 ft. and as it is a permanent work it is lined with concrete.

Test Borings—The boring at the Tanna basin was done at four points along the center line of the tunnel, at intervals of 900 ft. Three different methods were adopted: Diamond and calyx core drilling and churn drilling. The work began in March, 1924, and ended in February, 1925. The depth from the ground surface to the formation level of the tunnel was 519 to 604 ft. One of the drilling rigs in the mountain basin is shown in Fig. 5, where the white line shows path of tunnel.

FIG. 5—TRIAL BORING FOR TANNA TUNNEL, JAPAN
This fertile basin in the mountains is directly over the line of the tunnel, indicated by the white line.

Temperatures in Tunnel—Hot water at 25 deg. C. flowed out at a point 920 ft. from the east portal, the quantity being rather small. The highest temperature registered inside the tunnel is 86 deg. F., at a point 1,156 ft. from the east portal, and there the depth from the ground surface to the formation level is 188 ft. It occurred in June, 1919, when the temperature outside the tunnel was 71 deg. F.

Concrete Lining—Both on the west and east sides, the side walls are lined with concrete in place and the arch ring with precast concrete blocks, which are made at the concrete block plant near the portal. The concrete for side walls is mixed outside the tunnel and cast with shovels into forms fixed to the rock walls. Concrete, blocks and other material are carried into the tunnel by cars electrically operated. Work has begun at the block plant for building a cement storehouse and sand-and-gravel storage. Arrangements are also being made for carrying concrete materials by bucket conveyors up to the bin and thence dropping the materials into the mixers. The use of bucket conveyors for carrying concrete for side walls is also contemplated.

Accidents—On April 1, 1921, rock suddenly fell into the tunnel, burying a section about 200 ft. in length, starting just beyond a point of last lining, 990 ft. from the east portal. The thirty-three men then working there were buried; seventeen were rescued after eight days, but the rest unfortunately fell victims to the disaster. The cause of the accident was that the rock at that point had become so weakened by the action of hot water, that the earth-pressure gradually increased until it crushed the timbering. On Feb. 10, 1924, earth suddenly gave way inside the tunnel at a point some 4,950 ft. from the west portal, and mud rapidly flowed out. Of eighteen men then working there, sixteen were buried or shut in. The mud, forced out by water-flow, was very difficult to remove, but after seventeen days, or on Feb. 27, all the bodies were exhumed.

Engineers and Working Forces—The number of workmen engaged on the east and west sides is 400 and 370 respectively, or 770 in total. They are working on a three-shift basis, eight hours per day. In the main heading the work is done by the Japanese Government, workmen being obtained from labor contractors. The main heading for the whole length of the tunnel is divided into short sections, which are successively widened by contract work. The widening on the east end is done by the Tetsudo Kogyo Kaisha (Railway Engineering Co.) and that on the west by Seiichi Kashima Co. All equipment and materials, except those for timbering, are supplied by the government.

K. Kusuda, the writer, is now in charge of construction of the Tanna tunnel; Y. Hatta is director of the construction bureau of the Japanese Government Railways. It is expected to complete the work on the Tanna tunnel at the end of March, 1929.

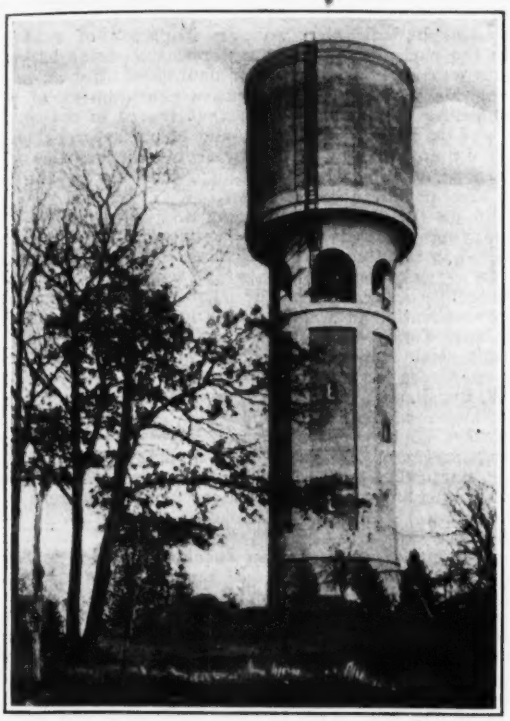
New Tower for Water Tank Houses Pumps at Rochester, Minn.

Booster Pump Takes Water from Main Leading to Standpipe Built in 1887 and Delivers It to High-Service Tank

A COVERED reinforced-concrete water tank of 200,000-gal. capacity supported on a tower of the same material which houses a new centrifugal booster pumping plant was built by the city of Rochester, Minn., in the fall of 1924. The new tank supplements a 25x62-ft. wrought-iron standpipe of 240,000-gal. capacity put up when the original works were built in 1887. The old standpipe is still in use. The tank and pumping plant are parts of improvements to the water-works which include in addition tubular wells, near the main pumping station, additional pumping plant at the main station, a 16-in. force main from this station to the business district of the city, and a reinforcement to the distributing mains. The main pumps deliver water to the city direct, the surplus going to the old standpipe and, with the aid of the new booster pump, to the new tank.

The new pumping plant at the main station includes a centrifugal pump, direct-connected on one side to a 200-hp. two-speed (1,200- and 900-r.p.m.) motor and on the other side to an 8-cylinder gasoline engine. At 900 r.p.m. the pump will deliver 1,500 g.p.m. to a proposed new reservoir (mentioned later) and at 1,200 r.p.m. it will deliver 2,000 g.p.m. to the standpipe or give a direct pressure of 110 lb. on the distribution system. The auxiliary gas engine can be run at any desired speed up to 1,200 r.p.m. and on several tests has delivered 2,000 g.p.m. or more.

The old standpipe was built in 1887, as a part of the original water-works, and appears to be in fair



COMBINED WATER TOWER AND PUMPING STATION, ROCHESTER, MINN.

condition. It is located on high ground, but is now surrounded by some of the principal residences in the city. These need the high-level service which the new tank affords. The new tank and tower are located about 200 ft. west of the old standpipe, on the highest ground available, but only some 12 ft. above the base of the standpipe. The high-water level of the tank is about 70 ft. above the top of the standpipe, but the normal water level of the tank is 90 ft. above that of the standpipe, owing to fluctuations in the latter.

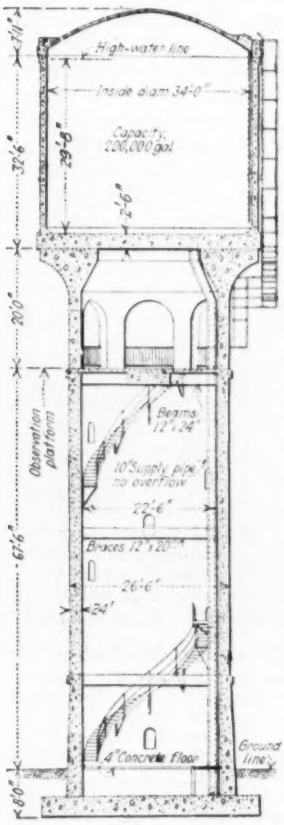
The booster in the base of the tower, which supplies the new tank from the force main leading to the old standpipe, has a capacity of 550 g.p.m. It is a centrifugal pump, direct-connected on one side to a 40-hp. motor and on the other to a 4-cylinder gas engine. Normally, electric power is used, the operation being automatically controlled by means of an ordinary gage-type pressure regulator, and also by a special device which cuts off the current if the regulator fails.

The new tank has an inside diameter of 34 ft., a water depth of 30 ft., and its bottom is about 90 ft. above the ground level, and 98 ft. above the bottom of the foundation slab (see section for additional dimensions). The walls and floors of the tank are waterproofed. The pilasters, columns and belt courses of the tower have a rubbed finish and the panels and tank walls are rough-cast stucco.

The walls of the tower and tank were constructed by means of sliding forms, 4 ft. high, held by timber yokes about 8 ft. apart, in which were hollow jack-screws which gripped the 1-in. round vertical reinforcing bars. The concrete was poured and the forms raised continuously at the rate of 8 ft. in 24 hours.

The designing engineer for the improvements was L. P. Wolff, St. Paul, Minn., and the contractor for the tower and tank was the Bland Engineering Co., Minneapolis. We are indebted to C. E. Forest, of the company just named, and to Mr. Wolff for the information given above.

Mr. Wolff states that he has recommended the construction of a 2-m.g. reinforced-concrete reservoir and the subsequent abandonment and removal of the old standpipe. The reservoir would be just north of the new tank. Its water level would be about 12 ft. above the base of the standpipe, thus giving a somewhat reduced pressure in the low-level district, but one that would be adequate.



SECTIONS OF WATER TANK AND TOWER AT ROCHESTER, MINN.

Through the courtesy of Robert A. McKean, general manager Riter-Conley Co., Pittsburgh, we have received the following information regarding the old standpipe:

"W. C. Coffin, now living at Miami Beach, Fla., informs us that the material for the Rochester standpipe, and for several others forming parts of works built by Hinds & Moffett (afterward Moffett, Hodgkins & Clarke) 'were made of iron bought in Philadelphia from the Baileys and the Houstons (Quakers).' Mr. Coffin also states that he went to Philadelphia 'several times a year with Mr. Riter to buy iron.' Of the material available for standpipes in those days Mr. Coffin remarks: 'Pittsburgh plates were too narrow and about the only steel plate was Bessemer, as brittle as glass. About 1890-91 open hearth steel came in at $2 per ton above the price of iron. Then we used steel in the lower rings and iron in the upper, as we saved enough weight to pay the additional cost, figuring steel at 60,000 and iron at 45,000 lb. tensile strength.'"

Mr. McKean comment as follows on the general subject of steel in standpipes: "The life of steel seems to be rather indefinite. Structures that we built as much as 25 and 30 years ago, being used in standpipes, tanks, stacks, et cetera, apparently are still standing. On the other hand we have instances of steel used in standpipes built as late as 1902 where the upper rings have actually rusted away."

Canada's Highway Cost Last Year

A report prepared by A. W. Campbell, Dominion Highways Commissioner, shows that during the year 1924 there was expended upon the roads of Canada a total of $31,413,097, of which $23,000,000 was for construction, $1,500,000 for reconstruction and about $7,000,000 for maintenance. The total expenditure was $10,000,000 less than in the previous year.

Why Water Mains Burst

An Octogenarian's Memories and Interpretations of Tests at Rochester Fifty Years Ago—Comments by B. C. Little

RUMINATIONS on the recent bursting of water mains at intervals of a few days in New York City carried the memories of Rossiter Johnson, octogenarian editor and author, back to the city of Rochester, N. Y., and led him to think that they did things better in the city of his birth (1840) than has been done in New York City in later years. Whereupon from the shades or sand, as the case may be, of Amagansett, Long Island, Mr. Johnson wrote the letter to the *New York Times* reprinted below. Appended to the letter is a reply sent to the *Times* by Beekman C. Little, superintendent of the Rochester water-works and secretary of the American Water Works Association, which differs from Mr. Johnson's letter as to the facts in the pipe-testing incidents and their application to the physical integrity of pipe and the moral integrity of pipe manufacturers and inspectors.

WHY WATER MAINS BURST

And What Was Done in Rochester to Insure Safety

To the Editor of The New York Times:

An aqueous volcano in the streets of New York is not a pleasant thing to encounter or even to read about. And it occurs too frequently. Listen to a story of something better:

When the city of Rochester constructed its water-works the cast-iron mains were made, under contract, in another state. And when they were ready for shipment a man was sent thither to inspect them before they should be accepted. Equipped with a strength-testing hydraulic apparatus, he appeared at the foundry.

The first pipe to which he applied the test burst at once. "Oh, of course," said the contractors, "we always expect that in a thousand castings there may be an imperfect one somewhere." "Just so! But let me try another." The second went the way of the first. The contractors looked grave and declared they never had known such an accident before. "Probably the rest are all right; you don't need to try any more," said one, while he put his hand into his breast pocket as if to draw out something. "Yes, probably they are; but it is best to prove it." And the third pipe followed suit.

Then came attempts at cajolery and hints at bribery, followed by more than attempts at profanity. But my old schoolmate, Joseph McMaster, was the most matter-of-fact man I ever have known. Nobody could buy him or scare him. He was not one to put his hand to the plow and look back. He plowed his way through the entire consignment and smashed every pipe. The explanation had been evident to him when he saw the fragments of the first pipe. All had shown the required thickness at the visible ends. But in the central portion they were not more than half as thick. While the outside was a straight cylinder, the space inside was shaped like a barrel, bulging at the waist. This saved the contractors many tons of metal.

I believe there never has been an aqueous volcano in the streets of Rochester, and for its exemption the city owes a grateful remembrance to McMaster, who did his duty, his whole duty and nothing but his duty.

By the way, he was a graduate of Rochester University, where he took prizes in mathematics and oratory. Now let us cancel one of those sneers at college graduates. He belonged to the same Greek-letter fraternity as the Dawes brothers.

ROSSITER JOHNSON.

Amagansett, L. I., Aug. 5, 1925.

To the Editor of The New York Times:

Sir—In his enthusiasm for Rochester, and love for the memory of an old friend, Rossiter Johnson has, I am afraid, exaggerated some statements in his letter published in the *Times* of Aug. 10, and has created a false and harmful impression—and he a newspaper man too!

Yes, Joseph McMaster was an inspector of cast-iron pipe in the early days of our water-works—some 52 years ago, and was an honest inspector doubtless. But as to his "plowing his way through an entire consignment of pipe and smashing every one?" No; that record is not on the books and is hardly believable, and manufacturers would not "save many tons of metal" by trying to pass this pipe, as all cast-iron pipe was bought and paid for by the ton, not by size or length or thickness.

But to go further: We do have, and always have had, with varying intervals of time between them, "aqueous volcanoes" in the streets of Rochester. That is, in Rochester as in every other city, breaks and leaks in water mains do occasionally occur. Rochester is not exempt in this respect and the implication in Mr. Johnson's letter that the officials of the New York Water Bureau are perhaps being bribed or permit slack inspection, or that the pipe manufacturers are criminals, is very unjust and not at all deserved.

W. W. Brush, deputy chief engineer, Department of Water Supply, under whose direct supervision comes the distribution system of New York's water supply, is possibly by education and practical experience the best equipped man for that particular job to be found. Certainly he has the respect and confidence of all water-works managers who know of his work and accomplishments, and his ability and integrity are unquestioned.

There are undoubtedly stricter specifications for cast-iron pipe and better and more complete tests made of all water-works material now in New York City than obtained in Rochester in Mr. McMaster's day. Cast iron is I think conceded to be the very best material to be used for distributing mains in a water system except in some special cases, and its use is almost universal wherever public water supplies exist, yet the mains do break sometimes in spite of the best methods of manufacture and careful inspection. Cast iron will not give or bend and a heavy blow or a succession of light blows may shatter it.

Consider the conditions that exist in New York City. Most of the streets have been dug over, tunneled under and blasted through and the subsurface is filled with electric conduits, telephone ducts, gas pipes, sewers and subways, all tending to make it very difficult to get a firm foundation the entire length—on the bottom—of another trench in which the water main is laid. If one portion of the trench settles, the main is apt to settle at that place and *cast iron won't bend.* Overhead mayhap are 6-, 8- and 10-ton trucks and many times heavier trolley cars, continually pounding on the pavement, and the shock is carried down through to the water pipe, and *continual hammering will break cast iron.*

Is it any wonder that occasionally some spot in the upwards of 1,400 miles of water pipes lets go?

The marvel is that even with the utmost vigilance in construction exercised by your competent water bureau officials, there are yet comparatively so few of these calamities.

BEEKMAN C. LITTLE,
Superintendent, Bureau of Water.

Rochester, N. Y., Aug. 13.

[Mr. Little's reply appeared in the *Times* of Aug. 19, with the subhead: "Rochester Official Disclaims Immunity There. Praises Our Officials." Mr. Little understates the mileage of water mains in New York City, which is nearer 3,500 miles owned by the city, besides about 700 owned by private water companies.—EDITOR.]

Proper Road Width

In a little volume recently published on the highways of Norway it is told that in the year 950 A.D. a law was enacted which, among other requirements, stipulated that "a main road should be as wide as a spear was long, the shaft of which rested on the ground and to the head of which a mounted man could reach with his thumb." Real national direction of public roads in Norway began in 1274 and last year there was formally celebrated in Oslo the 650th anniversary of that event.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Steel Frame Textile Mill Building with Concrete Floors

Save Floor Space, Cost and Erection Time With Steel—No Fireproof Casing—Wood Blocks on Floors—Wood Sash for Double Glazing—Enclosed Fire Escape Stairways

IN PLANNING a new steel-frame factory or textile mill for the Narrow Fabric Co., at Reading, Pa., the floors were designed for an unusually high live-load and all interior steel was left exposed, instead of being cased in tile or concrete fireproofing. Wood sash was used throughout, although at considerable extra expense. This new structure is identical in size with one built in 1919, but the latter is of reinforced concrete throughout, with floors of the flat-slab type and brick curtain walls. Among several reasons for the adoption of structural steel framing with concrete slab floors in preference to reinforced-concrete construction were: (1) A considerable saving in space on account of the columns being smaller, (2) saving in time of erection, and (3) saving in cost due to leaving the steel exposed. On account of the sprinkler system and the maintenance of an efficient fire department by the mill company, as well as the fact that the chances of fire are very slight, the insurance companies allow the same rate for this new building as for a strictly fireproof structure. Both buildings, which are parallel and 100 ft. apart, are 90x456 ft. in plan, with 12-ft. basement and four stories, 15 ft. high from floor to floor. The interior framing forms panels generally 18x18 ft., which was found to be a convenient spacing for the mill machinery.

In the new building, the basement is for shipping and stock; on the first floor are the sample, distributing, finishing and supply departments; the second and third floors are devoted to the manufacture of one-thread lace, and the fourth is for the weaving of all kinds of narrow fabrics, such as shoe laces, hat cords, corset strings, rick-rack, garters and suspenders. The Jacquard frames for the looms on the top floor, of which there are two in each bay, are supported by adjustable steel hangers suspended from the roof beams, as shown in Fig. 4. Toilet rooms are provided on all floors. About 300 employees are engaged in this building.

Framing and Floors—The steel frame consists of H-section columns with girders and I-beams framed between them, the spandrel beams having channel and angle-iron lintels to carry the brick curtain walls. Concrete footings just below the basement floor support the columns, except that for the two rows of columns alongside the pipe tunnel the footings are level with the tunnel floor and are surmounted by reinforced-concrete pedestals extending up to carry the column shoes at basement level, as shown in Fig. 2.

FIG. 1—NARROW FABRIC MILL, WEST READING, PA. South end with main entrance. At left is covered passage to adjacent building.

A view of the skeleton frame is shown in Fig. 3, with some of the structural details in Fig. 5. Columns

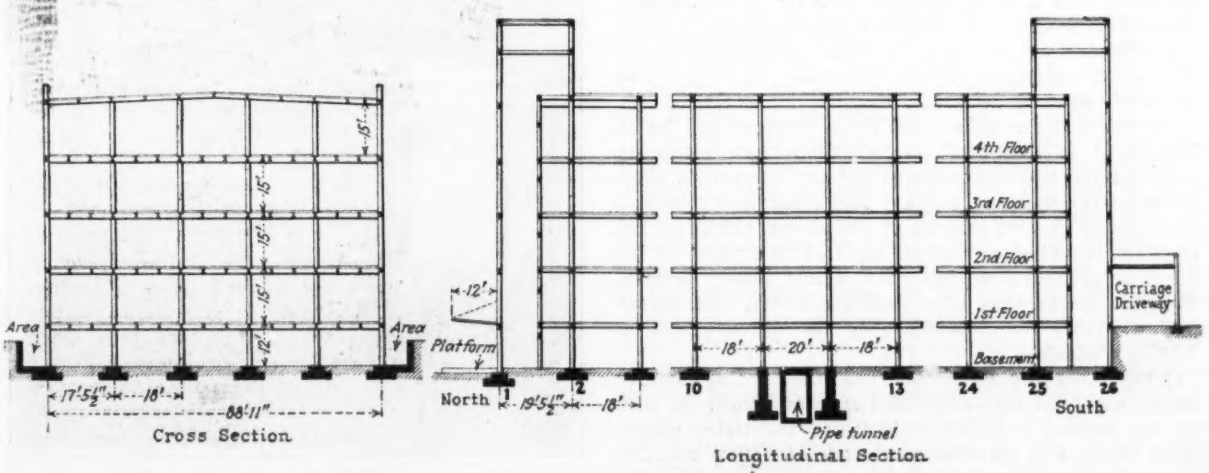


FIG. 2—TYPICAL SECTIONS OF STEEL-FRAME MILL BUILDING

are of 10-in. H-beams to the third floor, and 8-in. above. For the floors, there are 18-in. I-beams as transverse girders, with 12-in. I-beam joists framed between them, each bay having two intermediate joists. In the finished framing, the tops of girders and beams are flush, to carry the concrete slab. For the roof, which has a slope of ¼ in. per foot, there are 12-in. girders and 9-in. joists, with a single intermediate joist in each bay. All steel is left exposed (see Fig. 4), with the exception of wall columns and spandrel beams. The floors are 4-in. concrete slabs resting on the top of the steel beams and reinforced with electrically welded wire-mesh. Transverse expansion joints, with U-shaped copper sheets and mastic filling, are placed at intervals of 72 ft. Electric conduits are embedded in the slab, while the flanges of the beams carry hangers for the sprinkler piping, which is hung between the floor girders.

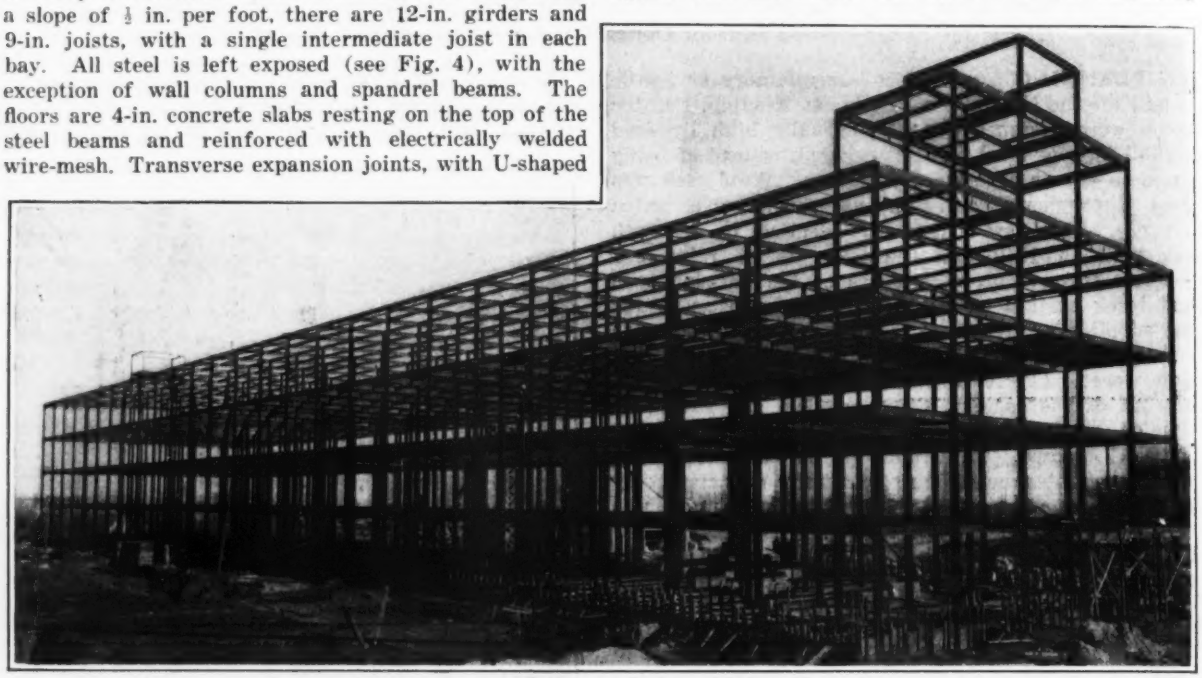


FIG. 3—STRUCTURAL STEEL MILL BUILDING

No special top finish is given to the concrete, as the floor has a wearing surface of 2-in. creosoted yellow-pine blocks laid on an asphalt coat on the slab. At floor openings, the flooring is retained by a concrete curb. This wood flooring was adopted for purposes of comfort, wearing qualities and ease of trucking. The basement has a 4-in. concrete slab on a 6-in. cinder bed and is covered with the same wood flooring. Cement finish is used for the floors in toilet rooms and for the stairs. Steel frame details are shown in Fig. 5 and some of the floor details in Fig. 6.

All the floors are designed for a live-load of 150 lb. This load is somewhat higher than that ordinarily required for textile buildings, but the company's engineers have found that a heavy and rigid floor construction is desirable on account of the severe vibration and constant trucking, as well as the fact that parts of the floors are used sometimes for fairly heavy storage. For this reason they have used the 150-lb. load in the design of all the buildings for the manufacture of textile products.

Walls, Roof and Windows—The walls are of common brick, with red face-brick and Indiana limestone trim on the outside. Interior partitions for toilet rooms, stair shafts and elevator shafts are of hollow tile, but the main part of each floor is an open space occupied by machinery. The inside of the walls was given a coat of asphalt and then plastered; the partitions and ceilings also are plastered. These plaster surfaces are finished with kalsomine down to the level of the window sills, below which they are finished with gray oil paint. The exposed steel is painted white and gray to correspond with the walls. On account of its insulating properties, a 3½-in. gypsum slab is used for the roof; this is lighter than concrete and requires lighter steel framing. Upon the slab is a four-ply composition roofing.

Wood sash was used throughout, in view of the fact

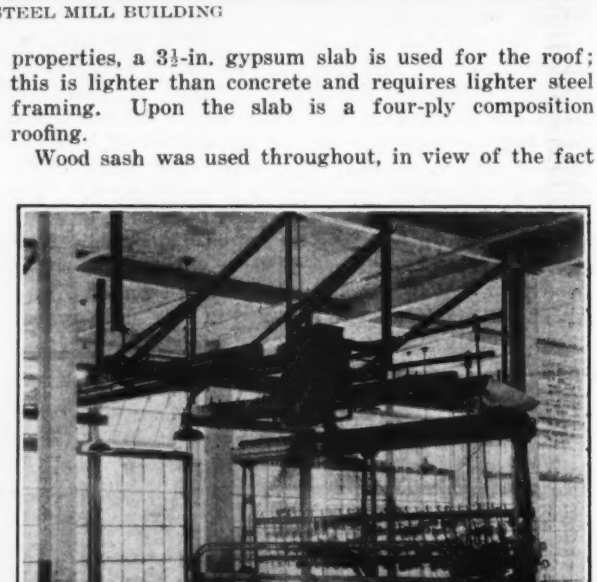


FIG. 4—LOOM WITH TOP FRAME HUNG FROM ROOF BEAMS

that a humidifying system may be introduced on some floors, in which case double glazing will be desirable. This construction was somewhat expensive, its actual cost being about $28,500, while the lowest bid for steel

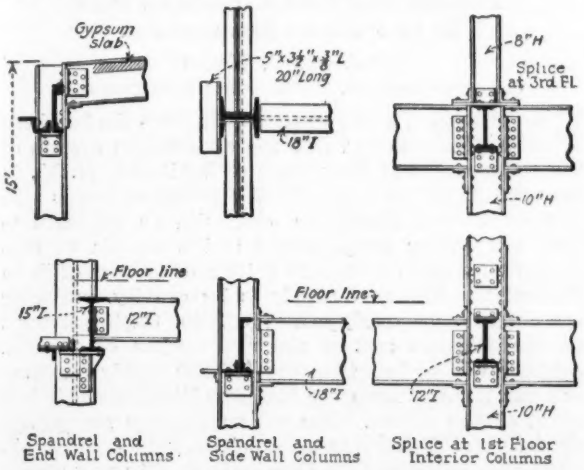


FIG. 5—STEEL FRAME DETAILS AND CONNECTIONS

sash was about $9,340. These figures cover the special construction for future double glazing but do not include glazing and painting. The windows, constituting a large proportion of the wall area, are fitted with double-thick factory glass. Ventilation is provided by pivoted sash. Along each side of the building extends an areaway 4 ft. wide and 2 to 12 ft. deep, supplying light and ventilation for the basement. These areaways have reinforced-concrete retaining walls of the cantilever type, as shown in Fig. 7.

Stairways and Elevators—At each end of the building is a 2-ton electric freight elevator, and on the west side are three enclosed concrete stairways with adjacent smoke towers for fire escapes. This arrangement is shown in Fig. 8, from which it will be seen that doors from the main room or working space open into a landing in the tower, from which another doorway opens into the enclosed stairway shaft. All stairs are of reinforced concrete. Along the north end of the building is a 12-ft. concrete platform, level with the first floor, for receiving and delivering goods. The platforms of the two buildings are connected to form a continuous stretch of 280 ft. A railway siding enters the plant but does not serve the building directly.

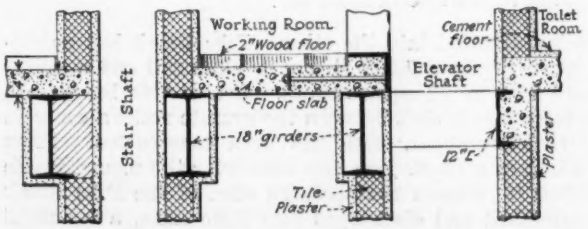


FIG. 6—FLOOR, WALL AND FRAME DETAILS

All interior handling of material is done with two-wheel and four-wheel hand trucks averaging 150 lb. loaded. At the south end there is a one-story passage, 18 ft. wide, of brick and steel construction, connecting the first floors of the two buildings.

Power and Light—On the west side of the building is an underground electric substation 44x47½ ft., and 16 ft. high, with its floor 9 ft. 2 in. below the basement and its roof a foot below the ground level. This substation is outside the mill building, the area wall forming one of its sides. It is of reinforced concrete, with heavy roof beams and slab and with four interior columns to support the roof. This room contains six transformers of 100 kw. and six of 200 kw. for the light and power service of the building. Current of 1,200 volts is received here from the power station of the Metropolitan Edison Co.

Pipe Tunnel—Steam heating pipes are laid in a tunnel from the power house of the Textile Machine Works, which serves also the Berkshire Knitting Mills, the three plants being affiliated. This tunnel, shown in Fig. 7, is 6 ft. wide and 8 ft. high, lined with concrete, having its roof slab just below the basement floor slab, and its floor level with that of the substation. Channel inserts across the roof and placed vertically in the side walls provide for attachments for pipe or conduits. When the first mill for the Narrow Fabric Co. was erected, the tunnel was discontinued in the first bay, so that when the second building was planned it was necessary to extend the tunnel under the basement floor across the bay of the first building in order to serve the new building beyond it.

On excavating to the bottom of the column footings

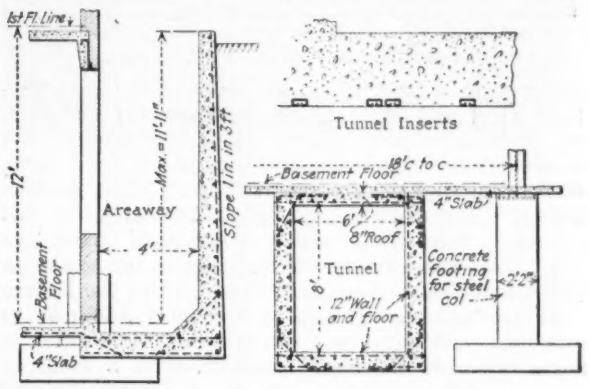


FIG. 7—AREAWAY AND PIPE TUNNEL

to determine the nature of the supporting soil, it was found that while some of the footings rested on solid rock the greater number were on loose rock and clay. These footings were 9 ft. wide and 5 ft. 10 in. above the bottom of the excavation for the tunnel. To prevent the columns from slipping, a 12x12-in. yellow pine timber, with special end castings made to fit the columns, was placed horizontally between each pair of columns at the floor level and wedged tightly against them. The tunnel was then excavated and concreted and the basement floor replaced, no underpinning or shoring being used. When the lining was poured, a reinforced-concrete beam 3½ ft. wide was formed between each pair of columns at floor level, the timber braces above the floor being removed after the concrete had set. This tunnel was built in open cut to and across the new building so as to provide for serving a possible third building beyond. It will be noted from Figs. 2 and 7 that the columns adjacent to the tunnel have concrete pedestals carried down to footings level with the floor of the tunnel.

Rock excavated for the basement, which is mainly in solid limestone, was crushed at the site and used for the concrete and on other building operations, while some was sold to contractors. For this purpose a jaw crusher was installed, with a screening plant and 100-ton overhead bin, from which stone was fed by gravity to the mixer. The cost of this crushed stone, including overhead expenses and depreciation of crusher, was $1.10 per ton.

Design and Cost—The cost of this building was 21.8c. per cubic foot, including elevators, heat, light and sprinkler equipment, a tower clock and automatic time-

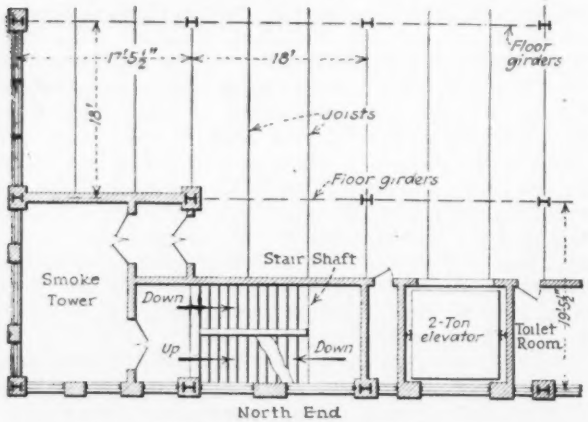


FIG. 8—SMOKE TOWER AND STAIR SHAFT

pieces on each floor. Contracts were let for the structural steel and its erection, and for the elevators, sprinkler system, roof slab and roofing. But with these exceptions the building was constructed by the force of the construction department of the Textile Machine Works, which department also acted as architect and engineer. This department was organized in 1923 to carry out an extensive building program for the three plants mentioned above, which form one of the largest combinations of textile mills in the country. It includes architects, designing and construction engineers and mechanical and electrical engineers, with a force of about ten office employees and 125 outside men during busy seasons. The work on the Narrow Fabric mill described above was all planned and carried out under the direction of J. P. Sartz, organizer and manager of the Textile Machine Works Construction Department, Reading, Pa.

A Public Water Supply Dating from 1250

Tiverton, an English borough of 9,715 people living in 2,499 inhabited houses, has had a water supply since 1250. In that year, states J. Siddalls, late borough engineer of Tiverton, in a paper before a district meeting of the Institution of Municipal and County Engineers (London *Surveyor*, May 22, p. 504) Isabella, Countess of Devon, gave a water supply to Tiverton (whether the source only or that and works also is not stated). Water was conveyed from springs at Norwood Common, 5½ miles distant, by a "leat or 'lake'" to Tiverton. "On reaching the town," says Mr. Siddalls, the water "was formerly distributed by conduits and channels through all the streets and byways," but whether general distribution was practiced as early as 1250 is not made certain. In 1880, settling tanks, filter beds and a small service reservoir were built at a point on the "leat" 2½ miles from and 200 ft. above Tiverton.

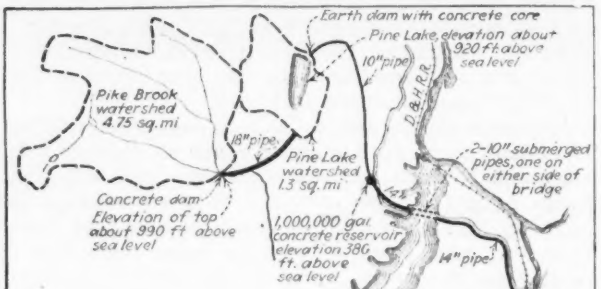
New Gravity Water Supply for Whitehall, N. Y.

Two Drainage Areas United by Diversion of Water Through Pipe Line Exposed on Rock To Low Winter Temperatures

BY JAMES P. WELLS
Consulting Engineer, Rochester and New York City

FEATURES of a new water supply from the Southern Adirondacks turned into the distribution system of the water-works of the village of Whitehall, N. Y., in January, 1925, are a considerable length of water pipe laid almost unprotected on rock with an exposure to very low winter temperatures and a stretch of submerged pipe laid on the soft bottom of an arm of Lake Champlain. The new supply is by gravity, replacing one pumped at a yearly cost of $22,000. Capital charges on the $320,000 cost of the new system of 3-m.g.d. capacity will be less than the $22,000 yearly pumping cost for 1 m.g.d. from the Metawee River, immediately south of the village. The old supply was moderately hard and at times was unsatisfactory in quality. It was untreated except for chlorination. The new supply has a hardness of only 20 p.p.m. and is of high quality bacterially. The estimated population of Whitehall is 7,000 (4,917 in 1900 and 5,258 in 1920).

Since it is impossible to get an ample supply from a single drainage area between Lake George and Lake Champlain, two were drawn upon, the water from one


Earth dam with concrete core
Pine Lake, elevation about 920 ft. above sea level
10" pipe
D. & H. R.R.
Pike Brook watershed 4.75 sq. mi
18" pipe
Pine Lake watershed 13 sq. mi
2-10" submerged pipes, one on either side of bridge
Concrete dam Elevation of top about 990 ft. above sea level
1,000,000 gal. concrete reservoir, elevation 380 ft. above sea level
14" pipe
South Bay Elevation about 95 ft. above sea level
Whitehall

DRAINAGE AREAS AND PIPE LINES, WHITEHALL, N. Y.
Water diverted from Pike Brook to Pine Lake watershed and carried beneath South Bay.

being diverted into the other. Pike Brook has an elevation of about 1,000 ft. above Whitehall and a drainage area of 4½ square miles. Across this brook in a narrow notch cleft between the granite rocks a concrete arch dam 30 ft. high has been constructed. From this dam a 16-in. pipe line leads over the mountainside 6,000 ft., crosses the northern edge of the Pike Brook watershed and discharges into Pine Lake, a beautiful body of water about a mile long and a quarter of a mile wide. To make full use of this lake for storage purposes, two dams have been constructed, the lake level raised 7 ft. and an intake has been built 10 ft. below the surface. This gives 17 ft. of storage depth and 450 m.g. capacity.

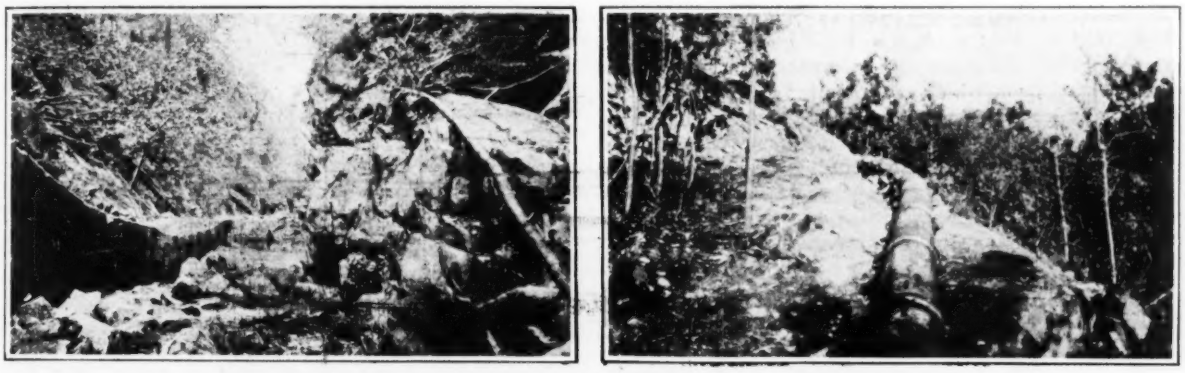
Leading down the mountainside from this lake is a 10-in. pipe line which drops 500 ft. in a little over three

miles and discharges into a 1-m.g. distributing reservoir. From this reservoir a 14-in. pipe line extends about ¾ mile to the edge of South Bay, an arm of Lake Champlain. As already mentioned, South Bay has always been considered as the great obstacle against a water supply from the Adirondacks. From the edge of the bay two 10-in. pipes about 500 ft. apart are laid across and on the bottom of the bay, the distance being 1,800 ft. The bottom of the bay is so soft that when a pile trestle was built across the bay, some years ago, it was very easy to push the piles down into the soft deep ooze. A small part of the pipe in the softest part of the bay was laid on cribbing. When the pipe was completed and tested some leakage occurred. This was stopped in a short time and there was practically no settlement. At the south side of the bay the two pipe lines again unite into a 14-in. main which extends three miles to Whitehall.

for this reason it was not deemed feasible to develop electric power.

The 1-m.g. reservoir already mentioned serves the double purpose of reducing water pressure and providing a reserve supply of water available at Pine Lake and Whitehall. To form this reservoir a semicircular earth dam with concrete heart-wall was built on a rocky slope. The earth in the reservoir basin was excavated to form the embankment, so that the entire bottom of the reservoir is practically upon granite rock. The inside slopes were riprapped. This reservoir will be operated in connection with an existing 5-m.g. reservoir which is located southwest of the village.

As the 16-in. pipe line from Pike Brook to the edge of the Pine Lake drainage area will not run full at certain seasons of the year it was necessary to guard against débris and driftwood, which would be apt to plug the pipe at the outlet of the arch dam. As this



CAST-IRON WATER-SUPPLY MAIN, WHITEHALL, N. Y.

Left, 16-in. pipe subsequently covered with concrete. Right, 10-in. pipe left almost completely exposed in country where temperatures drop to —45 deg. F. For nearly three miles the pipe is almost wholly on top of rock.

Several features of this construction are unusual and caused scepticism in many minds. First and foremost is the 10-in. pipe line from Pine Lake to the distributing reservoir. The temperature here sometimes drops to as low as —45 deg. F. and this 10-in. pipe is on top of the rock. Many of the natives said there was no question but that the water in this exposed pipe would freeze. The contention of the consulting engineer was that there would always be water flowing through the pipe and for that reason it would be entirely safe to lay the pipe on top of the rock. There is practically no covering material within a reasonable distance of the pipe line, so that the pipe is covered very scantily, possibly with 6 to 12 in. of whatever débris was available. Already the pipe has had a severe test—water flowing through it at low velocity when the temperature was about —45 deg. F.—with no appreciable decrease in the discharge of the pipe. When there is a higher velocity due to the use of water by the village, and at the same time a covering of snow, there will be no possibility of the pipe line freezing. The 10-in. pipe, which if laid on a flat grade could not carry more than 0.2 m.g.d., will carry 3 m.g.d. with the steep grade it has.

With all this additional head available, before deciding upon the size of the pipe, an alternate plan of developing power with the water was considered. This would have required a larger pipe and a good portion of it would have been under very heavy pressure, and pipe is primarily for the purpose of carrying off the flood water, and as the dam was constructed mainly to give sufficient head to carry the water over the divide, there is no objection to not using the small amount of storage that is available back of the concrete arch dam. To keep the intake free, a gooseneck or hump has been put in the pipe immediately in front of the dam. The top of the gooseneck is about 2 ft. below the level of the spillway, so that the water at no time will be below this level back of the dam, and there will always be about 12 ft. of water over the intake. By this arrangement the intake itself will never become clogged.

To exclude animals or foreign matter from the lower end of the 16-in. pipe, it discharges into a small reservoir created by a low concrete dam, from which it is the intention to let the water find its own course to Pine Lake.

Whitehall has purchased not only the entire lake but also a thousand acres adjacent to it so that it will own the entire watershed. Pike Brook watershed is sparsely settled so there is practically no danger of contamination from this source.

The two pipes across South Bay were laid from the end of a scow. The contractor for the work was J. J. Fitzpatrick & Son of Plattsburg, N. Y. The writer was the consulting engineer and E. P. Strowger was the resident engineer for him. The Central Foundry Co. supplied the pipe.

Electrically-Operated Gages Devised for Filters

Loss-of-Head Gages and Valve-Opening Indicators Consist of Voltmeters Actuated by Current Varied Through Reactance Coils

By Harry N. Jenks
Superintendent, Water Pumping and Filtration Works, Sacramento, Calif.

As a result of much experimental work at the Sacramento filtration plant, certain electrically-operated gages have been designed which, because of their improvement over existing types of gages used in the control of filter operation, are now being substituted for the mercury differential gages and special valve-opening indicators designed as part of the original filter equipment. A considerable part of this gage equipment will, however, be utilized in the new installation. It may be recalled from a previously published article (*Engineering News-Record*, May 11, 1922, p. 782) that in the Sacramento filter gallery the conventional operating table appears in the form of a marble panel board upon which are mounted the control levers for the hydraulic filter valves, and the usual indicating gages. This departure from ordinary practice has proved eminently satisfactory and, from the standpoint of the new indicating apparatus, the form and arrangement of the filter control panel boards are admirably suited to the mounting of the corresponding electrical instruments.

The location of control tables in filter operating galleries is practically always such as to necessitate the indication of the level of a water surface or the difference in level of two interrelated water surfaces, above the elevation of these surfaces. The difficulty of obtaining such an indication in comparison with the case where the indicating instrument is below the hydraulic grade line, or under positive water pressure, is well known. To overcome this difficulty several methods of design have been followed. Among the more important may be mentioned the use of floats in float pipes to give an indicating gage the required movement; the use of a float in a mercury well to actuate the gage; or the pneumatic transmission of the water pressures to the instruments on the operating board. All of these require extended or bulky piping and otherwise expensive apparatus in comparison with instruments performing similar functions in the electrical field.

The pneumatic method was tried at Sacramento. Such instruments as the rate-of-filtration and loss-of-head gages were made in the form of mercury differential U-tubes connected with cast-iron bell jars and operated by air pressure admitted to these jars which balanced the hydrostatic head represented by the water level to be measured. After much "tuning-up" it was found impossible to insure dependable readings of the U-tubes. The trouble was finally traced to the impracticability of keeping the water lines to the bell jars always free of air from the piping. This difficulty had been foreseen in view of the physical necessity of long water connections to the bell jars from the filters, rate controllers, etc., but experience showed that even with care in sloping these lines upward to their free ends, air-pocketing could not be avoided, with consequent unreliability of gage readings. Moreover, constant attention was needed to keep the gage system "blown up" with air.

In the case of the valve-opening indicators, intended to show the position of the hydraulic valves on the main filter piping, indication was made by means of a water column which traveled up and down in a gage glass

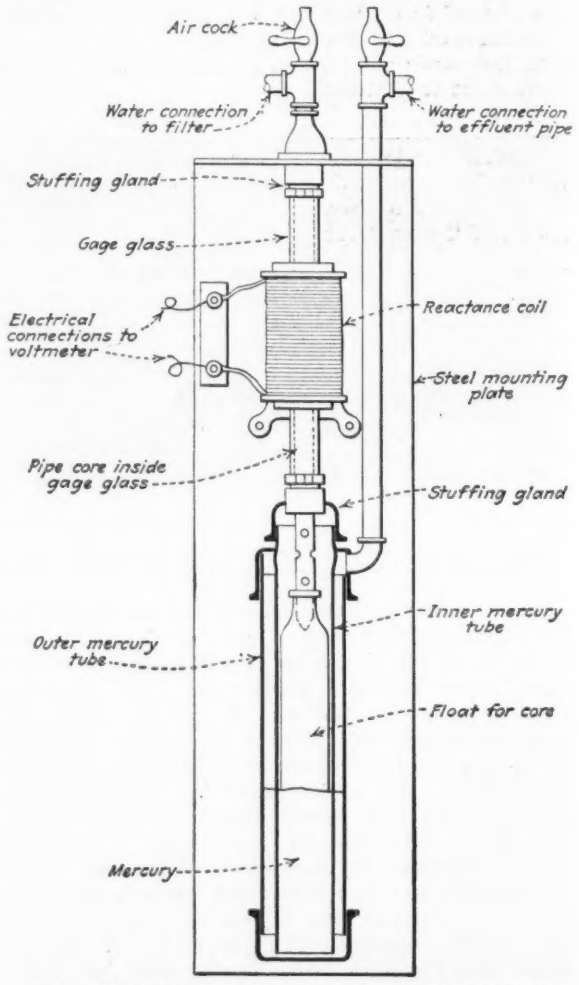


FIG. 1—DIAGRAMMATIC LAYOUT OF ELECTRICALLY-OPERATED LOSS-OF-HEAD GAGE

mounted above the control lever as the corresponding valve moved to the "shut" or "open" position, respectively. The movement of the water was produced by the displacement of a plunger rod in a brass pipe, driven by the valve stem follower, the whole mechanism being suitably mounted at one side of the hydraulic cylinder. Everything went well so long as leakage past the specially designed stuffing gland could be kept a negligible quantity, but after a thorough trial it was found that this feature required continual attention, with the result that the indicators fell into disuse. As the writer had had much to do with the design of the

details of the various gages as well as the general features of the panel boards, he felt more than usual interest in revamping that part of the equipment so as to make it function as well as it should.

Experimental Work Basis for New Design—After rejecting all other schemes involving mechanical and hydraulic means of transmission, attention was directed to the idea, advanced by Carl M. Hoskinson, chief engineer of the plant, that the problem be solved electrically. After much experimentation, it was determined that the simplest means of electrical transmission would be to move a core through the field of a coil of magnet wire, making use of the well-known principle of electrical resistance termed reactance. The applicability of this device to indicate the travel of a valve stem was immediately apparent and it was decided to use it for this purpose. However, to incorporate the reactance coil in a loss-of-head gage assembly required the solution of a more difficult problem of securing a movement of the proposed core, proportional to the difference of hydrostatic pressure. It was realized that if this problem were solved, not only would a loss-of-head gage operated on this principle be possible, but a wide field of usefulness would be opened to the device in gages to indicate at any point remote from the source of water pressure any units based on differential pressure, such as discharge through orifices, Venturi tubes and other flow meters. Accordingly efforts were concentrated on the design of a special mercury U-tube to be placed in such a location as to be under positive pressure on both legs and to have enough power to impart to a suitable core floating on one of the mercury columns a movement strictly the same as that of the column itself, and hence in proportion to the water levels or pressures to be indicated.

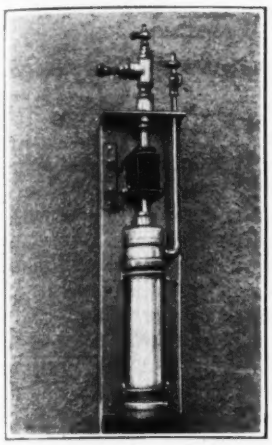


FIG. 2—REACTANCE COIL MERCURY U-TUBE ASSEMBLY

At the same time a thorough experimental study of the characteristics of reactance coils was made. These investigations threw some interesting light on the results of utilizing coils of different sizes with cores of various shapes, in connection with indicating instruments, both ammeters and voltmeters, of dissimilar electrical characteristics. In its bearing upon the present problem, the most important discovery made during the course of the experiments was the possibility of placing an alternating-current voltmeter in series with the coil and so in effect obtaining a remarkably sensitive ammeter reading. This is considered one of the most important and useful features of the new device, because of the fact that almost the full range of the voltmeter scale is brought into play in response to the reactance of the coil when operating on a very weak current and low voltage. The practical outcome of this fact is that a relatively small coil may be used, and, as the current consumption for one coil is something less than 100 milliamperes, a battery of gages may be operated through a single transformer, while the low current permits the readings to be transmitted over comparatively long distances without loss in accuracy due to drop in potential. Finally, with the "hook-up" just described, slight variations in voltage on the primary circuit of the transformer have relatively negligible effect on the voltmeter readings in comparison with the movement of the pointer produced by the smallest change in the position of the core that it is desired to indicate. Another interesting fact learned through experiment was that a long, thin coil with few ampere turns could advantageously be used with a low impressed voltage and a type of voltmeter having a low, full-scale reading. Such a combination is most suited to indicate the travel of large-sized valves. How the foregoing principles have been applied may now be shown by describing the actual design of the loss-of-head gage and valve-opening indicator installation for the Sacramento filters.

Loss-of-Head Gage—A typical installation of this equipment is shown by Fig. 1. It comprises essentially a reactance coil mercury U-tube with water-pressure

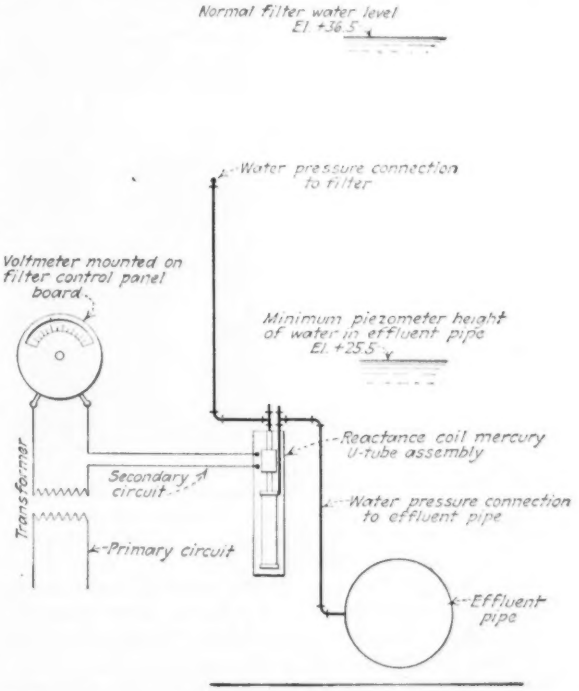


FIG. 3—COIL AND MERCURY TUBE WITH CONNECTIONS
Mercury column causes movement of core proportional to difference in water pressure.

connection to the filter and to the effluent pipe, and electrical connections to a voltmeter mounted on the filter control panel board. The U-tube may be located at any convenient point below the minimum water level concerned in its operation.

The voltmeter is a standard a.c. 0—15 volt front-of-board type, pattern 74, Jewell instrument, in series with the reactance coil. Current is supplied from a 110-volt a.c. circuit through a small transformer, which gives 24 volts on the secondary circuit, the coil operating on this voltage with a current less than 100 milliamperes.

Fig. 2 is a photograph of the reactance coil mercury U-tube assembly, shown also in cross-section in Fig. 3. The U-tube, of the concentric column type, is made of

standard steel pipe and fittings. The outer surface of the inner pipe is turned down in a lathe to form a thin shell and to provide the proper annular space between it and the outer pipe. A suitable round glass bottle is the float for the core and rests on the inner mercury column. It is weighed by filling with paraffin to counteract the buoyancy of the water in which it is immersed when the U-tube is in operation. The core, consisting of a piece of steel pipe, extends upward into a gage glass joined to the U-tube through a stuffing gland. The core is turned down smooth and to a thin shell in a lathe and is perforated along its length to induce water cushioning between it and the inside surface of the gage glass. Also larger holes near the junction with the float permit free access of the water through the core into the inner leg of the U-tube.

The reactance coil is a standard, General Electric, 110-volt high resistance solenoid coil, 2½ in. long by 2 in. in diameter. The coil is mounted around the gage glass so that the core may move in and out of the coil as the mercury column rises and falls. Zero adjustment is secured by moving the coil mounting in slotted holes provided for the purpose through the back of the instrument. The entire assembly is mounted on a steel plate which is bent at right angles at the top, forming a protection for the coil and serving as a support for the upper stuffing gland of the gage glass. The complete instrument occupies a space approximately 4x4x24 inches.

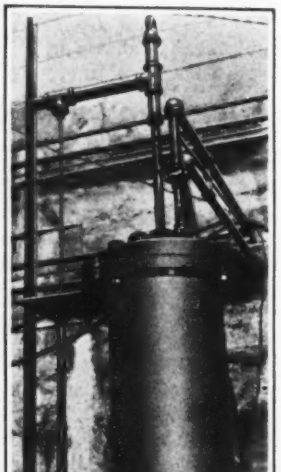


FIG. 4—ACTUATING MECHANISM AND COIL FOR VALVE-OPENING INDICATOR

The water pressure connection to the filter is made through the top of the gage and thence to the inner mercury column, while a similar connection is made between the filter effluent pipe and the outer mercury column. Air cocks are provided to release air from the system, at the highest point.

When there is no deflection in the U-tube, the core is completely in the coil and the voltmeter on the panel board reads zero loss of head. As the loss of head increases, pressure on the outer leg decreases, allowing that column to rise and the inner column to fall, which withdraws the core from the coil. This increases the current through the indicating instrument and causes a corresponding increase in the loss-of-head reading. The dimensions of the U-tube assembly are approximately proportioned to produce a movement of the core for each foot loss of head that will result in a deflection of the voltmeter sufficient to enable readings of 0.1 ft. to be made. Then the apparatus when installed is calibrated against piezometer water columns and a corresponding scale drawn for the voltmeter to read loss of head in feet, divided into 0.2 ft. intervals, with the possibility of estimating 0.1 ft.

Valve-Opening Indicators—On each filter of the Sacramento plant there are four main hydraulically-operated gate valves, as follows: 24-in. influent and wash-water valves; a 30-in. drain valve and a 14-in. effluent control valve. Based upon the results of experiments referred to in a previous paragraph, a long, small diameter coil with few turns of wire, impressed with a low voltage and connected in series with a voltmeter having a low, full-scale reading, is used to indicate valve travel.

On the panel board above each valve-control lever is mounted an a.c. 0—4 volt Hoyt "peephole" voltmeter. Each instrument is actuated by a reactance coil mounted, as shown in Fig. 4, on its corresponding hydraulic valve. The coil is wound on No. 18 gage ⅜-in. O. D. hard brass, unslit tubing (it was found that a full-scale deflection of the voltmeter was secured without the increase in reactance of the coil that might be obtained by slitting the tubing). The wire used is No. 24 double cotton-covered copper-magnet wire, approximately forty turns to the inch, the complete coil being about 1 in. in diameter. The coil operates on approximately 6 volts. The far end ("in" position of the core) of the coil is wound with more turns of wire in order to enhance the deflection of the voltmeter pointer near the zero end of the scale.

The core in each coil consists simply of a ¼-in. round steel rod, which produces a substantially uniform and full deflection of the voltmeter so that the only modification to the instrument that is necessary is to substitute for the "volts" scale one which gives the valve-opening from "closed" to "open" positions by quarters; intermediate positions can be readily estimated by eye.

Cost and Adaptability—It is believed that the cost of the electrically-operated filter control gages and indicators built in accordance with the design developed under the writer's direction for the Sacramento filtration plant is much less than for any other type of installation commonly used for such purposes. The loss-of-head gage (and similar gages), complete, should not cost more than $45 each, ready for installation, which is a simple matter. Likewise, a valve-opening indicator can be made, ready for operation, for $10.

As to adaptability, the principles involved may in general be applied to a great variety of uses in and about filtration, sewage or industrial plants. At any desired remote point, indication may be had of pressure, differences in pressure (such as are involved in the flow of water), or physical motion.

In connection with the successful development of this type of apparatus at the Sacramento filtration plant, valuable assistance in the application of the electrical principles involved was given by Carl M. Hoskinson, chief engineer, and credit is due him and the electrician and machinists of the pumping plant for their helpful co-operation.

The present article has been written so that free use of this invention may be made by the engineering profession.

NOTE CONCERNING PATENTS—Since the time that the apparatus described in this article was perfected and the first set of gages placed in operation, the writer was informed by a representative of the Water Works Supply Co., San Francisco, who visited the filtration plant, that his firm, through independent research and experiment, had devised and applied for a patent on similar apparatus. Judging from what was stated regarding their method of applying the principle of reactance, it is, however, apparent that in certain important respects their design differs materially from that described herein.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

COURT HOUSE SQUARE, LEXINGTON, KY.

Lexington, Ky.

COUNTY SEAT OF FAYETTE COUNTY, 82 miles south of Cincinnati, Ohio. Center of the blue-grass region. Long noted for its horses, race tracks, tobacco trade and Bourbon whiskey. Claims oldest running track in the world, purchased in 1826. Has various manufactures. Site of Kentucky State University and Transylvania University. Named Lexington June 5, 1775, by campers, in honor of Battle of Lexington, Mass., April 19 preceding. Surveyed and permanently settled in 1779; incorporated a town by Virginia Legislature in 1782 and as a city by Kentucky Legislature in 1832. Population (est. 1924) 45,000.

UNDER the commission plan of government which prevails in Lexington, Ky., the city engineer is subject to the immediate direction of the commissioner of public works and is free from control by any other single commissioner, although the commission as a whole could give him instructions. The commission has five members. In it are vested all the legislative and administrative powers of the city except those pertaining to education, which are in the hands of an independent board of five members, appointed by the mayor. The mayor is elected for a four-year term and the other commissioners for two-year terms.

The city engineer is in charge of all construction work ordered by the commission, except buildings, and has general charge of building construction. More specifically, the city engineer is responsible for the design and construction of streets, including curbs, gutters and sidewalks, and of sewers and bridges. Specifications for the new garbage incinerator recently contracted for by the city were reviewed by the city engineer. Construction of buildings is supervised by the building inspector, who, like the city engineer, is under the commissioner of public works. In the case of the new garbage incinerator, recently contracted for, the contractor's specifications were reviewed by the city engineer. Curb and sidewalk lines needed by property owners are given by the city engineer.

Sewer repairs and cleaning are directed by the city engineer and, as to their general features, street repairs also, but the city engineer has nothing to do with street cleaning and sprinkling, which are in charge of a superintendent under the commissioner of public works. Nor has he anything to do with the collection and disposal of garbage, which is under the health board—a body appointed by the mayor and coming under his general administrative control as commissioner of affairs.

Assessment Plan—Assessments for benefits, including sanitary sewers under 10-in., pavements, curbs, and sidewalks, are computed by the city engineer, who in about 1910 obtained the adoption of a plan simpler than that formerly used and one that is now quite generally followed in nearby municipalities. Briefly stated, this plan, in which the city engineer takes pride, is to divide the entire cost of any stretch of work by the entire frontage, both public and private, and levy the resulting "city frontage" and the "private frontage" respectively. What the plan amounts to is this: Property owners pay on a pro-rata basis for their frontage and the city pays for all the rest—pavements, sewers, curbs and sidewalks at street intersections. No exceptions are made for variations in street width on a single job, or for corner lots or for difference in lot depths. Before the "simplified plan" of assessments was adopted there was much contention by property owners about assessments under conditions out of the normal. Some complaints against the simplified plan were made for a while after its adoption, but these have nearly all stopped.

All storm sewers are paid for by the city. All sanitary sewers of more than 10-in. diameter are classed as "main line sewers" and their entire cost is also paid for by the city, from bond issues; but on these main-line sewers there is a "tapping charge" of $25 for each house connection, payable when made. On the 8-in. sewers (now the minimum size) there is no "tapping charge."

Grade Crossing Elimination—Another contribution by the city engineer to a financial problem was related to meeting the cost of viaducts over railways. The city engineer and mayor together obtained an agreement with the railways by which the entire $120,000 first cost of two over-crossings was met by the railways, the city's half being paid back to the railways by installments in five years. A similar plan for a railway undercrossing is now under consideration.

Pavements—Practically all the paving in Lexington has been done under the direction of the present city engineer, the main exception being some pavement laid in 1892. In other words, nearly all the paving work has been done since 1910. Today 60 of the 75 miles of streets in Lexington are paved. The materials used, in order of amounts, are: Concrete, which makes up most of the mileage, sheet asphalt, brick, creosoted wood block, and (for short dead-end streets only) macadam. Some of the macadam is surfaced with an asphaltic cement. Curbs and sidewalks are nearly all concrete, in recent practice (freight rates on limestone and granite now prohibitive). Steel protection bands are used in curbs at corners and in the business streets. Monolithic rather than two-layer concrete has been used for sidewalks during the past ten years.

In opening new streets the initiative is taken either by property owners, by petition, or else by the city commission; in the latter case the proposal can be blocked by the opposition of a majority of the property owners.

Sewerage and Water—Consulting engineers were employed on the original sewers and later for the disposal works. The earliest plans, which included disposal, were made by Col. George E. Waring, but only a small mileage of sewers was built under them. About 1903 Hering & Fuller were employed as sewer engineers and bonds voted. The first work done for the city by the present city engineer (then deputy) was on sewers to

provide data for Hering & Fuller. In 1917, Solomon & Norcross, of Atlanta, Ga., were engaged to design sewage-works and outfalls thereto. Their plans for Imhoff tanks and sprinkling filters were adopted. Delay in construction was caused by an attempt to substitute an electrolytic process but this was unsuccessful and in 1919 treatment works in accordance with the original plans were put in operation. A considerable part of the sludge from the drying beds is taken away by farmers without payment to the city.

Sanitary sewers have been laid in about 65 miles of street, compared with a total street mileage of 75 miles and 60 miles of paved streets. Sewers are available for about 85 per cent of the population; some 75 per cent is actually connected and the percentage is rapidly increasing. There are still in Lexington a thousand or more primitive privy vaults and some hundreds of houses to which water has to be carried by hand from yard hydrants from one to five or more houses distant.

The water-works of the city of Lexington is owned by a private company.

The staff of the city engineer consists of a deputy, two rodmen and four inspectors. Only the city engineer and his deputy are engineers. Appointments of the city engineer and his staff are made by the commission as a whole upon recommendation of the commissioner of public works.

There is no charter requirement or other regulation that prevents the city engineer from doing private work, either within or outside the city. He sometimes establishes private property lines and does work for other municipalities, with private assistants for such details.

The present city engineer, J. White Guyn, has been city engineer since 1910 and was deputy city engineer from 1905 until 1910. Until the commission plan went into effect in 1912, both the city engineer and the deputy city engineer were elected by popular vote. Mr. Guyn was elected deputy shortly after graduation from the engineering school of the University of Kentucky at Lexington. Since the commission plan took effect, or rather since his elective term expired, Mr. Guyn has been appointed and reappointed by successive commissions, the term of office being two years. He has only praise to offer for the commission plan. Under it, at Lexington, the commission as a whole assumes responsibility for the government of the city and if a commissioner falls down in the administration of his department, the commission takes charge of the department or assigns it to another commissioner. In the one notable case of the kind since 1912, Mr. Guyn was called upon to reorganize the work of the department of public works.

There is no complete topographical map of Lexington. A start toward it was made as a part of the Waring sewerage plan over thirty years ago but it has never been completed and brought to date. Official street and curb lines and grades have been established for most of the city but this was done and continues to be done street by street as necessity arises, except that in some new subdivisions the lines and grades were established when the plots were laid out. New subdivisions are supposed to be officially established by the City Planning Commission and a county judge but this has not always been done, owing to doubt as to the constitutionality of the law making this compulsory.

The bonded indebtedness limit of Lexington is fixed by the State Legislature at 10 per cent of the assessed valuation and the tax limit at $1.50 on $100, not including a School Board rate limited to $0.75. An additional levy can also be made by the city or by the School Board for interest charges on any bonded indebtedness incurred before 1890. The bonded indebtedness of the city is now $2,300,000 and the assessed valuation $50,000,000, which makes the bonded debt margin $2,700,000.

Various Needs—A garbage incinerator was built in about 1908. It is still in use, taking mixed refuse, but it is getting old and overtaxed. It is located in the city and is becoming the subject of complaint. A contract was let in April for a 45-ton Nye incinerator, to be located near the jail, city quarry (which is worked by city prisoners) and city sewage-works. Some of the "wet garbage" of the city is fed to hogs at the jail, the number thus fed sometimes reaching sixty.

No zoning plan has yet been adopted. A civic center site has been recommended by George B. Ford, of New York City, the scheme adopted by the city commission, some land condemned, and $500,000 of bonds for land, a city hall and auditorium approved by popular vote, and a short length of street has been widened. The land will cost $150,000; the $350,000 remaining is not enough for the proposed building, and a mayor who has come into office since the Ford plan was adopted wants to have the proposed buildings face another way than is called for in the Ford plan. The issues seem to have been somewhat obscured by the changes made or proposed so the public is uncertain whether the intention is to build a city hall or an auditorium or a combination with a fire and police station worked in.

Engineering Work

City Engineer's Appeal Against Dismissal Up for Hearing in State Court

THERE are to be heard before the full state supreme bench in Pittsfield, Mass., in September, arguments in mandamus proceedings instituted by Charles E. Wells, former division engineer with the New York City Board of Water Supply and for many years with the Bureau of Reclamation, against certain North Adams city officers as the result of Mr. Wells' dismissal last April from the office of city engineer of that place. The prominence of Mr. Wells in the civil engineering profession and the facts concerning his dismissal make of the coming hearing a situation possessing much more than local interest.

Mr. Wells last year took the Massachusetts civil service examination for civil engineer, Grade E, and was the only one of five applicants for the position of city engineer of North Adams to pass the examination. He was appointed Oct. 25, 1924, and began work Nov. 1, 1924. The Massachusetts law requires that an appointee serve a probationary period of six months before his appointment becomes permanent. On Jan. 1, 1925, a new city administration became operative and the commissioner of public works who appointed Mr. Wells resigned a month later. The incoming administration was more or less hostile to the existing appointive staff and proceeded to dismiss the principal ones. Though a number of persons were dismissed soon after the new administration began to operate,

Of the Small City

Mr. Wells, he says, was assured that he would be continued in office. However, rumors were broadcast to the effect he was to be removed. When Mr. Wells confronted the new commissioner of public works, E. R. Doble, with the rumor that he was to be removed, Mr. Doble repeated his assurance that Mr. Wells would be kept on. Finally, on April 24, he was given a letter of dismissal effective as of April 28, two days before the end of his civil service probationary period.

Points at Issue—Though the commissioner of public works gave as the reason for Mr. Wells' dismissal the lack of need of a city engineer, that reason has been hotly disputed, particularly by those inclining to the point of view best expressed in the following editorial taken from the North Adams *Transcript* of May 4, 1925. This abstract of the editorial also indicates the general political situation in North Adams:

"Any pretense on the part of those who have been bossing the job since election day that it's all 'in the interests of efficiency' is rather spoiled by the record of original replacements. The city treasurer was not removed for incompetence. There is more than a suspicion that he was too competent to be entirely popular in some quarters. The city solicitor was not removed for incompetence. Like the treasurer, his work for the city was generally recognized as having been exceptional. The chairman of the board of health, during whose incumbency the city on a relatively small appropriation established new health records and brought from the state authorities commendation similar to that elicited by the work of the treasury department, was not removed for incompetence.

"So there naturally arises a very reasonable question as to any claim that other removals were inspired solely by a desire to 'serve the city.'

"Further comment on the city engineer in this connection is superfluous. As we have said, if the reason given for his discharge is a true one, it is one of exceedingly doubtful value to the city."

Mr. Wells contested the dismissal and through his attorney brought mandamus proceedings to restrain the commissioner of public works, Mr. Doble, or any of his subordinates, from interfering with the office of city engineer or performing any of its duties. The case was argued before Supreme Court Justice Crosby, in Pittsfield, July 7. Justice Crosby rendered no opinion, preferring that the argument be heard by the full bench of the Supreme Court. The court will sit in Pittsfield in September.

Mr. Wells' contention is that the city engineer is an administrative officer and that the commissioner of public works is not by the charter given the power to remove him, claiming that the authority of the city engineer is independent of that of the commissioner. The city solicitor who is handling the case for Mr. Doble contends that the commissioner of public works does possess the right to remove the engineer inasmuch as he is believed by the defense not to be an administrative officer since he is appointed by the head of a department. He admits that under the old charter the office of city engineer was administrative, but under the changes made in 1918 the city engineer was left off the list of administrative officers.

Under "Title 6, Administrative Officers," in the revised city charter eight specific administrative officers are named in the first section. In the second paragraph of that section is the following:

"The commissioner of public works shall have authority to appoint a city engineer who shall be inspector of buildings, a clerk and such assistants as he may deem necessary from time to time to carry on the outdoor and other work of the department." Under Section 40 of the same section, which, let it be emphasized, is titled "Administrative Officers," the duties of the city engineer are defined. In this section 40 certain duties which the city engineer has and which are not exclusively given to the directional control of the commissioner of public works, are defined as follows: "He shall perform such other duties as the city council or commissioner of public works may prescribe, not inconsistent herewith." It is upon this premise that Mr. Wells contends the office of the city engineer is an administrative one.

There are two additional contentions which are made by Mr. Wells' counsel, the first being that though the commissioner of public works is given specifically the power to appoint the city engineer, no power is assigned to him to dismiss the city engineer. The other contention Mr. Wells makes is that if the commissioner did have the authority to remove Mr. Wells, the removal was not legally accomplished, because it is alleged that the record of the removal was never entered in the office of the commissioner, who, as the counsel for Mr. Wells argued before Justice Crosby, kept only a carbon copy of the removal order while no record of the removal was filed with the city clerk as required by the 1918 charter. Thus it is contended by Mr. Wells' counsel that inasmuch as he believes the removal notice has not been legally complied with, Mr. Wells is permanent city engineer, the six months' probationary period having ended. The city solicitor argued that the new charter vested no authority in the engineer as an administrative officer but made him merely an appointive officer under civil service regulations and that these rules had been complied with in Mr. Wells' removal. He further argued that the authority of the commissioner of public works to remove the city engineer went with his power to appoint that official.

Sanitary Districts Authorized in Michigan

The organization of sanitary districts in Michigan in unincorporated municipalities is authorized by Chapter 19 of the laws of 1925. The act, according to C. M. Baker, state sanitary engineer of Michigan, in his quarterly progress report, is designed particularly for "summer resort communities where it is impractical to incorporate as a village." Under the law these districts acting through a commission of three members appointed by the town board, will have authority to construct, maintain and operate a water-works, sewerage, garbage or refuse disposal system and to adopt ordinances or rules and regulations relating to sanitation. The initiative for the formation of these districts would be by petition of 60 per cent of the owners of real estate or of the area of land not used for agricultural purposes within the proposed sanitary district. These petitions are filed with the town board which subsequently conducts hearings on the subject and establishes a district and fixes its boundaries.

Use of Iodides in Water Supplies to Prevent Simple Goiter

Case Presented, Professional Criticisms Reviewed, Plan for Minneapolis Outlined and Local Objections Analyzed

By Arthur F. Mellen
Filtration Engineer in Charge of Water Purification, Minneapolis, Minn.

For many years water-works men have been improving the quality of water supplies by the removal of disease-producing organisms, turbidity, odors and tastes and the reduction of color, hardness, carbon dioxide, iron and manganese. About two years ago a new line of attack was proposed which has since been put in operation at Rochester, N. Y., Sault Ste. Marie, Mich., and Virginia, Minn., and has been recommended by the writer and given strong local endorsement for Minneapolis, Minn. The new procedure is not one of removal but rather one of increasing the quantity of a substance almost universally found in water and essential to complete health, but so deficient over large areas as to cause affliction to millions. The substance is iodine, a deficiency of which in the water or food supply is the cause of simple goiter. Extensive studies show that the areas with large goiter incidence have low iodine in the natural water supplies and that those with high iodine in the water have little goiter. This deficiency is further aggravated by low iodides in present-day food supplies in these localities. The simplest and cheapest means of insuring that the iodine deficiencies in the low iodine sections of the country are made good seems to be through public water supplies, which are now available to a large percentage of the population. It should be understood that the proposal is designed for only the prevention of simple goiter and that all persons already afflicted should be under the care of competent physicians.

At the 1923 convention of the American Water Works Association, Beekman C. Little, superintendent of water-works, Rochester, N. Y., reported that he was adding sodium iodide to the water supply for the prevention of simple goiter, the plan being to use it twice a year for a two-week period. This is the first use of this method known in this country, and already beneficial results have been reported from Rochester, although the time is too short to note the full effects, and many of us believe that, particularly during the first year, inadequate quantities were used.

Adverse Criticisms Reviewed—The Rochester experience was made the basis of four papers given at the Ohio Conference on Water Purification held at Columbus late in 1923. These papers were disappointing because of their lack of balanced emphasis.

Dr. Emery R. Hayhurst, Professor of Hygiene, Ohio State University, in his paper on "Simple Goiter—An Iodine Starvation Disease" urged the use of sea salt without discussing the merits of other methods.

Dr. O. P. Kimball, director of the Cleveland Clinic, in "Endemic Goiter as a Public Health Problem" gave a splendid summary of the recent contributions to the subject of simple goiter and its prevention and recommended giving iodides directly to adolescent girls and boys and to expectant mothers. He estimated the cost of such treatment in the city of Cleveland to be $10,000 per year, while if iodides were used in the water supply it would cost about $125,000 per year. This estimate, which is his basis for considering it to be a wasteful method, is *ten times* as large as that given by J. W. Ellms, engineer of water purification, Cleveland Water Department, in his paper "The Use of Iodine in Public Water Supplies" given at the same conference. His estimate is $12,750 per year. This is not far from the figure of $10,000 per year and would have the great advantages of reaching those of pre- and post-school age and of avoiding a very complicated problem of public health administration.

Although Mr. Ellms began his paper with the statement that "The treatment of public water supplies with salts of iodine as a preventive of simple goiter has been recently suggested" he lost sight of the real issue and proceeded to question its therapeutic value, and in closing stated "it therefore appears to the writer that it would be far more effective and much less expensive to treat the individual directly for simple goiter, than to attempt the medication of an entire water supply."

As to the "waste" it should be said that sodium iodide, which is used for the purpose, is a chemical costing at the present time about $3.75 per pound. It is calculated that only from about ½ of 1 per cent to 1 per cent of the total water furnished a city is used for drinking purposes and in the preparation of foods. Very evidently a large part of the iodide would never reach the consumer. However, exactly the same argument can be used against the expensive processes of purification. It is just as reasonable to suggest that polluted unpurified water be furnished to the citizens, because each one could purify just the small quantities that are necessary for drinking purposes and foods at very small cost, as it is to object to the use of iodides in water because only a small part would be used. The goal to be reached is the prevention of simple goiter. The cost, as will be shown later, is very small.

Clarence Bahlman, superintendent of filtration, Cincinnati, read a paper "On the Application of Iodine to Public Water Supplies" in which he too dwelt on the so-called "wasteful method." He stated that the operating cost of the Cincinnati filtration plant is about $120,000 per annum. If only 1 per cent of the water supplied was used for drinking purposes or in the preparation of food someone might reason that there was $118,800 wasted which could have been saved if each one had purified his own drinking water; but the dangers that would be encountered are far too serious to give consideration to such a plan.

Health authorities demand that all water furnished a city be adequately purified for all purposes, the so-called "waste" to the contrary notwithstanding. Cincinnati, we may be certain, does not consider the purification of the 99 per cent used to flush toilets, sewers and streets, fight fires and wash automobiles to be waste but as a necessary safeguard to public health.

Mr. Little gave a second paper at the 1924 convention of the American Water Works Association, on "Sodium Iodide Treatment of the Rochester Water Supply." In the published discussion of this paper many were favorable to the proposal and spoke very highly of it, but the discussion of those who questioned or opposed it was indeed disappointing. Mr. Ellms again used an estimate of $12,750 per year as the probable cost at Cleveland, and not the figure of $125,000 which had been previously used by Dr. Kimball. Mr. Ellms was

afraid of the precedent set by using the water supply as a vehicle for making up deficiencies which exist in foods, and feared someone might want to add medicine to the water. He continues, "Whoever heard of Epsom salts being put into the public water supply of a community?" It is doubtful if this has ever been proposed, however, it is well known that these salts commonly occur in most water supplies, being "put in" by nature; that many other chemicals used as medicines as well as several poisons (e.g. arsenic and lead) are also present in many supplies but there has been no demand for their removal because those who know of their presence realize that they are not in sufficient concentration to do harm.

J. J. Hinman, Jr., chief of the water laboratory of the State Board of Health of Iowa, stated that he believed the administration of candies was a more direct way of getting iodine to children than its addition to drinking water, although he makes no comparison of the relative effectiveness or costs of these two methods without which the unsupported opinion can have but little weight. Mr. Hinman also dwelt on the probable effects of iodine treatment of a water, overlooking the fact, as did several others, that the proposal is entirely for the prevention and not for the cure of simple goiter.

N. J. Howard, bacteriologist in charge of the filtration plant laboratory at Toronto, stated that "My impression was that the medical profession largely opposed the treatment of goiter through water on account of the impracticability of administering a therapeutic dose."

The Minneapolis Plan—The Upper Mississippi valley and the basin of the Great Lakes are notably deficient in iodine. Minneapolis is in a region clearly shown by Dr. J. F. McClendon to have very low quantities of iodine in both water and foods. This seems to be the full explanation for the prevalence of simple goiter.

Those who suffer from this disease have not accumulated enough iodine to maintain the normal function of the thyroid gland. That many have escaped is presumably due to having at birth a thyroid well supplied with iodine and being fortunate enough to have foods supplied in proper quality and quantity to protect them.

The Minneapolis water supply is filtered Mississippi River water. It contains only about 0.8 of a part per billion of iodine. The smallest quantity of iodine found in waters of regions practically free from simple goiter is about 5 parts per billion. In order to make up also for the deficiency in foods in Minneapolis it would be necessary to have about twice this amount of iodine in our water supply.

On June 23, 1924, the writer submitted a report to N. W. Elsberg, city engineer of Minneapolis, entitled "The Proposed Use of Sodium Iodine in the Water Supply for the Prevention of Simple Goiter" in which he recommended that in order to make up for the deficiency which exists in our water and foods, sodium iodide be added to the water supply to the amount of about 10 parts per billion. This is approximately equivalent to 0.1 lb. of sodium iodide per million gallons of water. The recommendation has the support of Dr. F. E. Harrington, commissioner of health, Minneapolis, who is much concerned about this problem, Dr. Jesse F. McClendon, representatives of the Hennepin County Public Health Association, women's clubs, parent-teacher associations and many others. It was referred to the City Council committee on water-works which held three public meetings in order to give an opportunity to those who might wish to advocate or to oppose the recommendation.

As was expected there were many who did not favor the idea, either because of a lack of understanding of the proposal or because of basic opposition to such matters as vaccination, pasteurization of milk or the chemical treatment of water supplies. Those opposing the recommendation may be divided into five groups: Christian Scientists; anti-vaccinationists; anti-dopists; expense protesters; advocates of individual treatment.

The opposition of the Christian Scientists is consistent with their belief regarding the causes of disease, but their objections to iodine treatment would apply equally to the purification of water and the pasteurization of milk. It should be said that their statements were dignified and not of the obstructionist type used by certain others. They contended that the use of water containing iodides was medication and should not be forced upon them, but expressed their willingness to abide by the will of the majority. The anti-vaccinationists were represented by an attorney for the American Medical Liberty League. Mr. Little in his last paper showed that he had some experience with this organization which also resists medical inspection in schools, attempts to prove vaccination is not effective in the case of smallpox, asserts that chlorination of water has failed in its purpose and that typhoid germs are not dangerous. Their opposition was very vigorous, but the underlying principles which they hold are diametrically opposed to the policies which have guided most city health departments for many years, and their objections are not based on generally accepted scientific facts.

Those who fear "doping" or "wholesale medication" of the water supply asserted that they wanted their foods and water "pure," whatever that may mean. They do not realize that many of our foods are treated and adjusted to safeguard health and to improve their keeping qualities, and that the making up of deficiencies has been used for many years and is quite generally accepted in everyday life.

The objectors on account of the expense involved do not seem to realize how trifling the cost would be and how great the benefits. The cost would be about 1½c. per person per year which would surely be a very cheap method of eliminating or materially reducing simple goiter. It seems certain that if any of our other common diseases could be eradicated for even several times this sum the public would readily support the procedure. It is probable that the cost to the citizens of Minneapolis due to the loss of time from work caused by preventable goiter, the expense of hospitalization, together with the very considerable cost in our school system due to retarded pupils, would pay for the entire cost of iodides many times over each year.

Those who urge treatment for only the individuals who need it or who ask for it seem to be prompted chiefly by a desire to defeat the recommendation for general treatment through the public water supply. The problem of discovering each individual who may need iodides, the administering of it in proper amounts and checking up to be sure that each one has taken it consistently would involve a problem of public health administration which would cost far more than adding

the iodides to the water supply, and the results would be problematical at best.

The Committee on Water-Works of the City Council has recently reported favorably on this matter and has authorized the purchasing agent to call for bids on sodium iodide. It is hoped that we may be able to put the plan into actual practice very soon.

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Concrete Road with Machine-Molded Center Joint

Machine Molds Mid-Slab Groove Establishing Plane of Weakness for Longitudinal Cracking and Marking Traffic Line

A CONCRETE paving operation notable for a machine-formed center groove is in progress from Dover five miles out toward Little Creek in Delaware. The pavement is 15, 16 and 18 ft. wide, the wider sections being in streets, and is of the standard Delaware section shown by Fig. 1 except that the metal center joint is replaced by the machine-molded groove. Besides the operation of the grooving machine the operation shows the latest practice and equipment required in Delaware for finishing and curing concrete roads. A general view of the equipment is given by Fig. 2.

As shown by Fig. 1 the Delaware section provides thickened edges by using a sharper curve for the subgrade crown than for the pavement crown. Other dimensions and details correspond to general practice. A rolled subgrade is required which before placing concrete is tested by the templet shown by *A*, Fig. 3. A 1:2:4 concrete is used, counting one bag of cement as 1 cu.ft., and 0.1 cu.ft. of hydrated lime per bag of cement is added. The batch is mixed 1½ minutes. Figs. 5 and 6 show road grade structures on embankment. The cable guard rail has reinforced-concrete posts but otherwise is of familiar construction. The unusual structure is the shoulder curb and trough used where they appear expedient on embankment. This device has been successful in holding fills where wash and scour are normal hazards.

Construction operations are shown by Fig. 2. On this job the materials come in at Dover where there is an unloading plant comprising a traveling crane with a ¾-cu.yd. clamshell and a sand and gravel batcher. The proportioned batches, with the cement in bags, are hauled to the mixer in Ford trucks. All the hauling will be from one end. There are 30 trucks in operation. The mixer is a 21 E. Subgrade is kept finished 200 ft. ahead of the paver. With pneumatic tires as required, the damage is normally insignificant and can be readily handled in the final trimming for the templet, Fig. 3 *A*.

The deposited concrete is struck off and shaped by two templets of the construction shown by Fig. 3 *B*. The first or heavy templet or screed weighs 25 lb. per foot and has a 10-in. face. The weight of the second or finishing screed is 18 lb. a foot and it is 8 in. wide. Great care is exacted in using these templets. They are slid forward on the forms by a sawing motion 4 min.

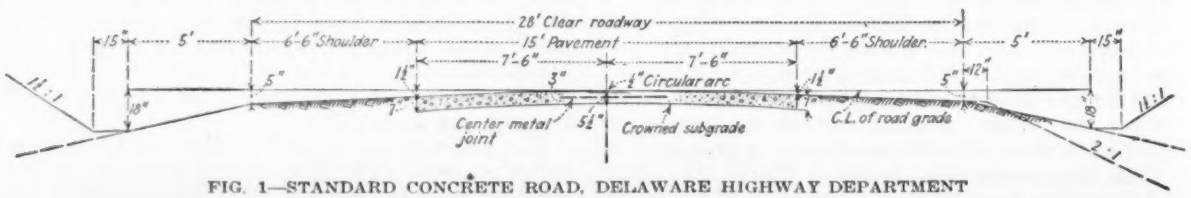


FIG. 1—STANDARD CONCRETE ROAD, DELAWARE HIGHWAY DEPARTMENT

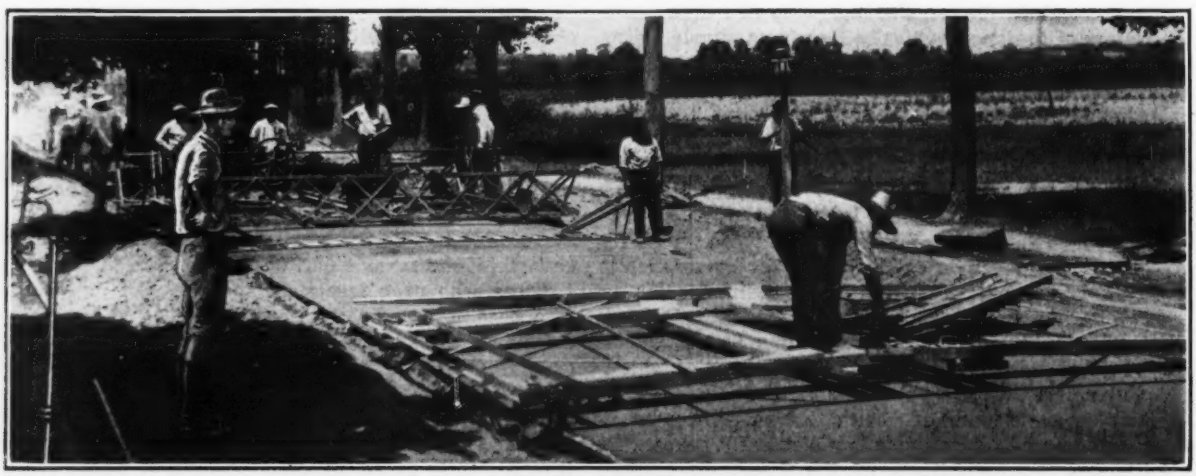


FIG. 2—PAVING WITH JOINT MOLDING MACHINE NEAR DOVER

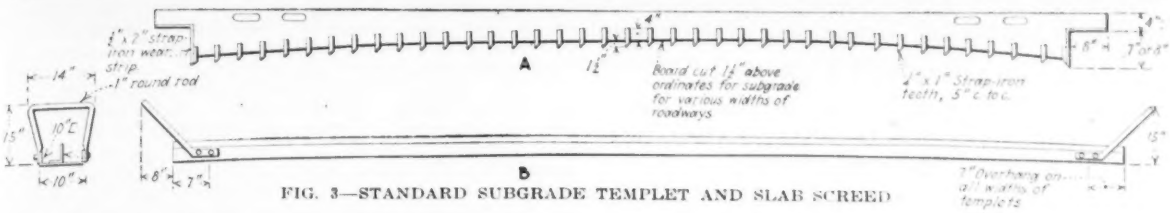


FIG. 3—STANDARD SUBGRADE TEMPLET AND SLAB SCREED

in the pit exerting a tamping action while shovels keep the concrete about 1 in. high on the face of the screed and the slab crown is truly formed. Striking off as required with these templets is heavy work and two men screeding, alternating from one templet to the other, have a stout task to perform.

The joint-forming machine follows close behind the final screeding. As indicated by Fig. 2 it consists of a trussed platform on flanged wheels traveling on the side forms. A handwheel turned by crank propels the platform along the forms and also operates a chisel, with an up-and-down motion like a sewing-machine needle, whose purpose is to make a place for the joint mold by pushing down and aside the coarse aggregate leaving a mortar channel in the middle of the slab. The chisel is on the front of the platform and in each operation makes a cut just long enough for placing one 10-ft. length of mold. The mold is a flat V of sheet steel into the open top of which fits a metal core strip. Core and mold are placed in a mandril device in the center of the platform exactly over the middle of the pavement. By screws the mandril forces the mold and core into the concrete and flush with its top. The mandril is then withdrawn and is ready to place a succeeding mold.

As soon as the mold is placed and the machine has moved ahead the slab is belted with a board belt 24 in. wide with handles as shown by Fig. 2. This belting is followed with a final belting with a muslin or cheesecloth belt whose purpose is chiefly to remove surplus

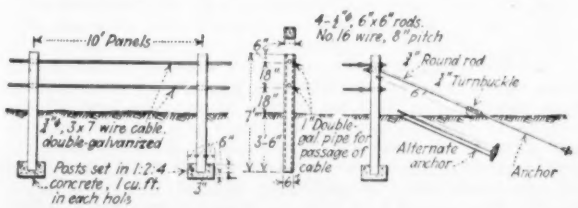


FIG. 4—STANDARD WIRE CABLE GUARD RAIL

water from the slab top and give a coarse surface grain by keeping down laitance. As soon as the finished slab has its initial set the center joint mold is taken out and the edges of the joint are rounded. The slab is then covered with burlap kept wet until final set and the dikes can be placed for ponding the slab. Fig. 2 shows the working bridge and the operation of pulling the joint mold. When the pavement is ready for traffic the groove is filled with a bituminous joint filler which serves as a traffic line mark.

In the Dover-Little Creek work the operating force consists of: 3 form setters, 9 men preparing subgrade, 2 men dumping batch trucks, 1 mixer operator, 1 mixer fireman, 4 pit men spreading, 2 men screeding, 2 men on center joint machine, 2 men finishing, 1 man pulling center joint, 5 men ponding (one for every 1,000 ft.), 1 foreman and 2 men testing subgrade. This force is averaging daily 700 ft. of 16-ft. slab and 800 ft. of 15-ft. slab. There are three inspectors—unloading

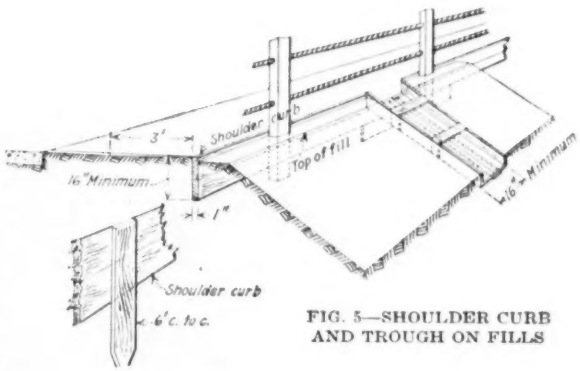


FIG. 5—SHOULDER CURB AND TROUGH ON FILLS

plant, subgrade, mixer—on the work which is under the direction of the State highway department, C. D. Buck, chief engineer, and Samuel Knopf, principal assistant engineer. The contractor is William Eisenberg, Camden, N. J.

Controlled and Aided Land Settlement—Why?

"We need a system which will enable John and Mary, who have saved a little money, to get married and enter on their life on a piece of land that is their own, and where they have a lifetime in which to improve and pay for it. That means longer credits, lower rates of interest and an attention to details in preparation for settlement similar to that which goes into the planning of a great industrial undertaking. It is not a matter for private enterprise because there is no margin for profit under the depressed rural conditions that prevail. It is doubtful if it can succeed at all, unless interest rates are based on what agriculture will stand, rather than on the current rates. That is the basis of land settlement in all European countries. The government pays the difference between the two rates. Control should be local. The federal government is too far away; but it can be a valuable co-operator, as it now is in agricultural education, road building, and many other things that vitally affect rural life. One demonstration will, if successful, do more to show what is needed and educate the public as to whither we are drifting than all the books which could be written. If it fails it will not end the need for action. We are confronted with conditions which have caused the downfall of civilizations in the past, and no effort, no expense or sacrifice will be too great to solve aright the fundamental problem of democracy: the relation of the people to the land."—Elwood Mead, Commissioner of Reclamation, before Farm Communities Conference, New York, May 5, 1925.

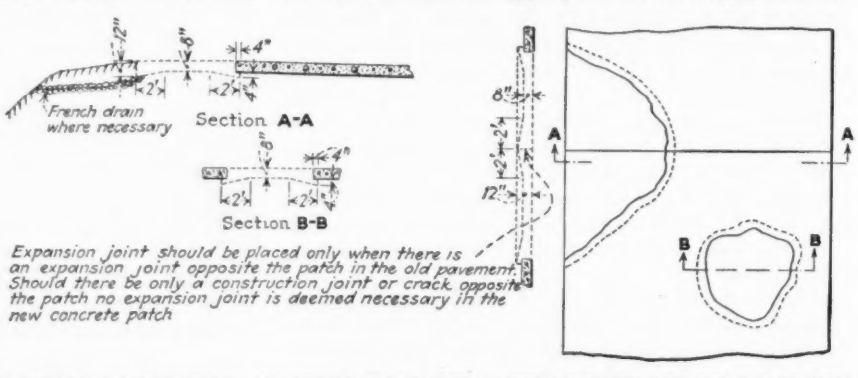
Quick-Hardening Concrete Patching with Ordinary Cement

Materials, Methods and Costs as Determined by Practice in Indiana—Extreme Care Required for Perfect Repairs

A method of patching concrete roads with a quick-hardening concrete made of standard portland cement was briefly described in "Engineering News-Record," Jan. 15, 1925, p. 114, as it had been developed by A. H. Hinkle, superintendent of maintenance, Indiana State Highway Commission. More precise details of practice have since been given by Mr. Hinkle in a paper read at the Annual Road School held at Purdue University. From this paper we take the following data and instructions.—EDITOR.

CUTTING away the old concrete can be done with picks, chisels, crowbars or a hand power drill. The use of a paving breaker operated by a small portable air compressor is the most effective method if any quantity of work is to be done. All the broken and disintegrated concrete should be removed and the old slab cut back until solid, rigid concrete is reached which has on top a smooth and uniform surface. The top edge of the old concrete should be trimmed by hand, with hammer and chisel, to a uniform and vertical edge for a depth of about 1 in. below the top surface. The remainder of the vertical edge of the concrete should be left as rough as possible. The base of the old concrete should be thoroughly brushed to loosen any spalled concrete.

The subgrade ordinarily should be excavated to a greater depth than the original slab. At its junction with the old pavement the new slab should be 4 to 6 in. deeper. Also, the new concrete should extend back under the edge of the old slab. The depth of the new concrete should depend upon the nature of the subsoil. The old concrete slab has failed for a reason. Quite frequently this reason will be found to be soft clay subsoil. Therefore, the thinnest new slab should usually be 2 in. to 4 in. deeper than the old pavement. In very bad spongy clay soil, not only should the depth of the new slab be increased but it is an added factor of safety to tamp into the subgrade a 3- to 4-in. layer of cinders, gravel, or broken stone with an outlet to the side ditch. This will reduce capillary action in the clay and also help drain the surrounding subgrade.


French drain where necessary
Section A-A
Section B-B
Expansion joint should be placed only when there is an expansion joint opposite the patch in the old pavement. Should there be only a construction joint or crack opposite the patch no expansion joint is deemed necessary in the new concrete patch
A
B

METHOD OF PATCHING CONCRETE ROAD FOR QUICK HARDENING AND EARLY USE

The concrete for the patches usually should be of a better grade than that used in good new concrete paving construction and it should be a concrete that will attain strength quickly so as to accommodate traffic with little delay. The time that traffic should be kept off the patch will determine the mix that should be used. The quick-hardening concrete will depend for its early strength upon: (1) Richness of the mix; (2) freedom from excess water; (3) use of $CaCl_2$; (4) comparatively high atmospheric temperatures, and (5) coarse sand and properly graded sand and coarse aggregate. All of the above factors affect the time of hardening of the concrete mix. If we combine the most favorable features of all the above factors in one mix, we can make a concrete which assumes as much strength in two or three days as the ordinary concrete mix used in paving assumes in 21 days.

Traffic should be kept off the patch the number of days shown in the accompanying table. During cold weather, traffic should be kept off the new concrete a longer period than given in the table as concrete gains strength more slowly at low temperature.

Materials—It is imperative that the cement be of good quality. Some brands of cement attain greater strength than others at an early date. It is desirable to use such cement for repair purposes, if it can be conveniently secured. The sand should be comparatively coarse, 95 per cent passing a ¼-in. mesh screen. It should be clean and free from silt or foreign material. Coarse aggregate should be crushed stone or gravel fairly well graded from ¾ to 2½ in. in size. If the concrete is to be used to fill a crack or very small opening, the maximum size of aggregate will have to be reduced accordingly. It is quite important that the exact quantity of calcium chloride material be used in each batch. An excess will weaken the concrete and insufficient calcium chloride will not hasten the time of setting to prevent the pavement from being injured by traffic when opened after the number of days given in the table. It must not be added directly to the drum as small undissolved particles remaining in the concrete will cause it to disintegrate. The calcium chloride shall be added in the form of a "Standard Solution" made by thoroughly dissolving one pound of commercial calcium chloride in enough water to produce one quart of solution. This "standard solution" should be placed in a keg, jar, or barrel and labeled "standard solution." Two quarts of the solution for each bag of cement should be added to the mixing water just before it is put into the drum.

Water must be pure and free from vegetable acids. The amount of water will have to vary so as to make the concrete of the proper consistency. In practice this will usually be found to be from 2 to 5 gal. per sack of cement. However, when all the aggregates are thoroughly saturated after a rain it may be found that 2 qt. of "standard solution" will be sufficient water to make the required consistency. It should be remembered that excess water will reduce the strength of the concrete and delay the hardening process and not only permanently weaken the concrete, but also lengthen the time traffic will have to be kept off the patch. In order to secure the hardening effect, the concrete will have to be sufficiently dry to show no more than the slump given in the table. Great emphasis should be placed on the importance of guarding against using too much water. The use of 3 or 4 pt. more water than is necessary in a one-sack batch will reduce the strength of the concrete more than extending the time of mix will increase it.

Methods—The subgrade and old concrete with which the new concrete comes in contact should be wetted before the new concrete is placed. The subgrade should be damp but not soft or sloppy. The edges of the old concrete should be saturated with water. It is very imperative, however, that no free water be present when the new concrete is applied, as the concrete that is to be opened to traffic soon after being placed depends largely for its quick strength upon having no excess water.

Only machine mixed concrete should be used. It is almost impossible to get a maximum strength concrete, which is very imperative in repair work, if one depends on hand mixing. The usual time specified for mixing ordinary concrete in a mixer is one minute. However, tests show that the strength of a dry mix may be increased as much as 10 per cent by mixing 1½ minutes, instead of one minute and the strength is slightly increased by extending the time to 5 or 10 minutes. Hence, in repair work and where a small mixer is used, which will generally be less efficient than the big paving mixers, and where a dry mix is required for a maximum strength and quick-hardening concrete, the time for mixing might well be placed

TABLE OF RATIO OF MATERIALS TO SECURE CONCRETE THAT CAN BE OPENED TO TRAFFIC AFTER ANY NUMBER OF DAYS

Days Patch Closed to Traffic	Proportions: Bags of Cement	Cu.Ft. of Sand (0 to ¼ in.)	Cu.Ft. of Coarse Aggregate (¼ to 2½ in.)	Lb. $CaCl_2$ or Qt. of "Standard Solution"	Water Add Enough to Produce Slump Given below, In.	Bags of Cement per Cu.Yd. of Concrete
2	1	0.5	1.9	2	1	11.8
3	1	0.6	2.1	2	1	11.2
5	1	1.0	2.7	2	1½	8.4
12	1	1.3	3.0	2	1½	7.6
15	1	2.0	3.0	2	1½	6.8
21	1	2.0	3.0	No $CaCl_2$	2½	6.8

at not less than 2 minutes. This increased time of mixing will also make the finishing easier.

Concrete should be shoveled in place and thoroughly tamped in layers not exceeding 3 in. in depth. The secret of the early strength of the concrete will largely lie in a comparatively dry mix hammered in place. A 10-lb. concrete tamper can be used for much of this work. A thin-edged tamper having a face, say, 1 in. x 6 in. should be available for tamping in narrow openings and along the edge and underneath the old slab. The concrete should be finished with a straight-edge and a wood float, to a regular and uniform surface to conform with the edge of the surface of the old pavement and the side forms.

Owing to the fact that we are dealing with a quick-hardening concrete when using calcium chloride, it is necessary to do the finishing promptly after the concrete is placed and tamped. After the concrete hardens to any extent it is almost impossible to make a smooth finish. It is important that the templet and straight-edge be used on finishing a partially completed patch so that the surface of the road will conform with the proper crown of the road and the old concrete surface.

The newly laid concrete should be protected against any and all kinds of traffic, the number of days specified in the table. It is desirable that extremely heavy trucking be kept off the patch longer than this, particularly if the concrete is laid in cold weather. The new concrete should be covered with 6 in. of earth or a layer of straw or sawdust, which should be kept dampened with water. Such covering should be kept on the new concrete about two-thirds of the length of the time traffic is required to stay off. The concrete should be protected against freezing the same period.

Cost—It will naturally cost much more to make concrete in small quantities as used in repair work than it will cost to make it in large quantities. Also the cost of cutting out the old concrete and making the excavation for the patch will be considerable. Furthermore, because of the variable conditions encountered with the different pavements being repaired, the costs will vary much more than in new work. The best approximate cost data that we have been able to secure in 1924 in making patches 9 in. deep are as follows:

First Job	Per Sq.Yd.
Cutting out old concrete and making excavations	$0.83
Materials delivered (aggregates, sand, cement, $CaCl_2$)	2.70
Labor (excluding making excavations)	1.44
Total cost per square yard	$4.97

This cost includes 10 per cent added for equipment charge.
Second Job—$3.10 per square yard. No excavation.
Third Job—$3.10 per square yard. No excavation.

Control of Pollution of Interstate Streams

Pennsylvania, acting through its State Department of Health, has entered into reciprocal agreements with its adjoining states for the control of pollution of their interstate waters. These agreements, according to W. L. Stevenson, chief engineer, Pennsylvania Department of Health, include (1) the Delaware River zoning compact signed by representatives of the health departments of Pennsylvania, New Jersey and New York (see *Engineering News-Record*, Aug. 10, 1922, p. 243), which sets up a standard for the treatment of sewage discharged into three different stretches of the river; (2) agreements between Pennsylvania, Ohio, and West Virginia; and (3) also between Pennsylvania and New York.

Serious Dry Rot Conditions in Alabama

ACCORDING to a bulletin just issued by the Alabama Polytechnic Institute (Auburn, Ala.), serious dry rot conditions exist in Alabama, particularly in the southern half of the state. There are many outbreaks in lumber yards, and through these and through direct infection from the ground, many buildings are attacked. Of 46 cases investigated by wood pathologists, 25 were in buildings and 11 in lumber storage sheds. The bulletin, by C. J. Humphrey of the U. S. Department of Agriculture, and L. E. Miles of the Institute, describes a number of the conditions that have been found to initiate or encourage dry rot infection and gives suggestions for methods to avoid or combat the disease.

By far the most important fungus involved is *Poria incrassata*. The initial appearance of this fungus is in papery, often fan-shaped, sheets of whitish mycelium with yellowish tinge, appearing on sub-floor timbers or timbers surrounded by moist atmosphere, as where covered by sheathing or plaster, or timbers in contact with the ground. The fruit bodies when fresh are of fleshy consistency, light greenish gray to white or yellowish in color, turning to brown or blackish and brittle when old and dried. The dried fruit bodies have an odor of slippery elm bark. The development of the fungus is so rapid that in one case, in Mobile, forms for a concrete floor, left under a new porch, decayed in nine months and the disease spread into the building, and damage amounting to millions of dollars resulted from the action of the fungus.

Other building materials also take the infection. Asphalt shingles and building papers may be destroyed. Tarred roofing may be rotted at the ends in contact with a decayed floor. Nail kegs on opening may show dense mats of fungus threads covering the nails. Boxes of hardware may be found heavily matted by the growth, both within and without. It is often known to invade valuable electrical instruments, stored documents and stationery, to discolor and warp cement asbestos shingles, and to attack wire fencing, which it depreciates in sale value apparently by its acid action on the galvanizing coat. In fact, almost anything with which it may come in contact will be deteriorated.

Adequate insulation of the wood (whether in storage or in the finished building) from the ground, the use of wood known to be uninfected, and preservative treatment are among the recommended remedies. Many details of construction that favor the holding of moisture in parts of the framework of buildings and thereby predispose to growth of fungus are indicated in the bulletin. A case is reported where a house set on posts about 3 ft. above ground was decayed throughout, because of infection transmitted up through the posts. In another case the fungus ran up through a wood block which the contractor had carelessly left under a sill of the porch; the effect was first noticed in the second story in the shape of dense mats of mycelium under the bathroom linoleum.

Wood preservation for the timber used in residential construction is strongly suggested by the authors. The cost for the ordinary house is estimated at not over $100. "From the standpoint of protection alone, the added expense of preservation then becomes the cheapest insurance a builder can take out in the South today." Attention is called to the necessity of applying several coats of preservative to any cuts made in the timber after the treatment.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Some Observations on Structural Behavior in the Santa Barbara Earthquake

Sir—I have read with great interest the articles by Henry D. Dewell in your recent issues of July 9 and 23 regarding the Santa Barbara earthquake. There are a number of points in his articles which I should like to discuss.

1. *Direction of Severe Earthquake Shocks, etc.*—Figs. 3 and 4, p. 150, issue of July 23, show arrows indicating the severe waves in a north and south direction, making an angle of approximately 45 deg. with State St. My two weeks' observations at Santa Barbara lead me to think that the severe moment was northeast and southwest, i.e., perpendicular to State St. This, besides being indicated in other ways, was shown as follows:

(a) By the movement of the battery of six transformers in the yard of the Southern California Edison Co. These transformers moved on their bases as follows: 7 in. to northeast; 3 in. to northwest; 3 in. to northwest; 6¾ in. to northeast; 5¼ in. to southwest; 2¼ in. to southwest.

(b) Brick wall sections parallel to State St. revealed little diagonal cracking; perpendicular to State St. a great deal more.

(c) The Granada Building, facing on State St. was much stiffer in the narrow direction perpendicular to State St. than in the other direction parallel to State St. Such damage as this building sustained was in the narrow direction, with very slight evidence of racking in the opposite direction.

If I am correct in my opinion, Mr. Dewell's sketches and accompanying discussion regarding the Arlington Hotel and San Marcos failures should be modified accordingly. I personally believe that the skeleton framing of the building with brick filler walls, which, beneath the heavy water tank, would be subjected to heavier earthquake stresses than elsewhere, was the primary cause of the Arlington failure to which all other causes were secondary. The fact that the only portion of this building to collapse—perhaps 5 per cent of the total area framed with concrete—was beneath the water tank certainly casts suspicion on the water tank. Following the lines of Mr. Dewell's reasoning, should not also the corresponding and similarly situated corner on the opposite side of the building collapse?

As for the San Marcos Building, I regard the skeleton construction and glass walls as the primary difficulty. The standing State St. portion has a concrete end wall and concrete walls around the stairs and elevators one panel removed from the collapsed portion; the standing Anapamu St. portion had brick filler walls for its full length in the rear, and one panel on the front; the collapsed portion, as near as I could determine, had one small panel of concrete wall 8 in. thick reinforced with ¼-in. square bars 18 in. c.c. both ways on both faces, and the remainder of the wall construction was glass or air. I would not controvert Mr. Dewell's statement that such corners of L-shaped buildings are severely stressed but I would emphasize the utter lack of lateral rigidity in the first story of the San Marcos Building at this corner.

2. *Structural Steel Buildings*—I found two at Santa Barbara; the bathing pavilion and the mill building at the plant of the gas company. The gas building, covered with galvanized iron, performed perfectly. The bathing pavilion was also structurally perfect, although it swayed sufficiently to crack the plaster rather extensively on stud partitions that flanked the main entrance. These were both low buildings. There were also a number of steel-framed water towers which, well braced and rigid, performed perfectly.

3. *The Christian Church*—This building is 61 ft. wide by 108 ft. long. A transverse portion of the main church, 40 ft. 6 in. long, is framed with well designed, well braced structural steel and the remainder of the building, including the main ground floor, is framed with well-designed, well braced wood. The perfect performance of the steel portion was matched in every respect by the perfect performance of the wood. The building has a stucco exterior on wood studding, and is not high, the steel columns being 21 ft. 9 in. long.

4. *Horizontal Shear in Columns*—A noticeable feature in the concrete columns in a number of buildings was the fact that at their tops, at the bottom of intersecting beams or column capitals, they showed a horizontal crack completely encircling the column. This may have been due to a combination of bending and horizontal shear as Mr. Dewell suggests, but having seen it in columns from which the plaster was not spalled or otherwise cracked, I can but believe that the cause was bending and direct stress acting on laitance and not on concrete. Certainly one outstanding lesson that Santa Barbara taught was the necessity of clean construction joints in columns, walls, and everywhere else. However, there is no more reason to be alarmed over the majority of these "sheared" columns than there is to be concerned over thousands of similar columns elsewhere with laitance in the joints, or over thousands of steel columns in which the intentions of the designers have been imperfectly carried out.

5. *The Post Office*—This is a low two story building not much over 25 feet high. I read with interest Mr. Huber's notes, "A crack in the outside of the pier nearest the street is the most evidence effect, and this is not serious structurally. . . . This is one more example of the superiority of this type of construction for withstanding earthquake shocks."

I believe the effect of the cracks is just as serious in this case as some of the diagonal cracks in concrete which have been referred to. Advice from Washington shows that the post office building has structural steel beams and columns in its interior, but no steel in the exterior walls which are bearing walls of brick. I therefore do not agree with Mr. Huber regarding the superiority of this type of construction.

Regarding shearing values in concrete, I recommend to interested readers Professor Slater's article in your issue of Feb. 27, 1919, p. 430, and certain other tests variously reported. But before worrying over the relative shearing values of structural steel and concrete, I would call attention to that fundamental of any economical engineering: It is always cheaper to carry loads by direct stress than it is by bending. The curious conception that earthquake forces can only be successfully handled by bending was put to a magnificent, large scale test in the case of the Marunouchi, Nippon Yusen Kaisha, and Japan Oil buildings in Tokyo. Their design and construction are outlined in your issues of Sept. 21, 1922, Sept. 13, 1923 and Sept. 20, 1923. One paragraph heading in these articles is entitled, "Japanese eager to learn." Well, they have learned. When the test was over, the structural frames of these buildings were presumably unimpaired and they looked like the Central Building, or the Carillo Hotel or St. Vincent's Hospital at Santa Barbara. They have now been restored and reconditioned with every effort to make them as stiff and rigid as may be. When it comes to designing against earthquakes with structural steel, put in *designed*, diagonal bracing or a proper amount of *designed* reinforced-concrete wall section, and with reinforced concrete do likewise.

Seattle, Wash.,
Aug. 7, 1925.

H. M. HADLEY,
District Engineer, Portland Cement Association.

Highway Improvements In and Near Boston

Highway improvements in and around the city of Boston which have been authorized and which within another year should be ready for travel include: Widening of Cambridge, Court, Tremont and Kneeland Streets, cost $6,140,000; rearrangement of Dock Square, $1,320,000; construction of a northern and a southern artery, $3,990,000; extension of West Roxbury Boulevard, $222,000; and widening of Morton St., Dorchester, $325,000. The total cost is $12,927,000.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Rensselaer Polytechnic Starts New Courses

General Science Course Split Up Into Three Courses for Broader Technical Training

Rensselaer Polytechnic Institute, which for many years has given four courses leading to engineering degrees and one course in general science, has replaced the general science course by three others, one in which chemistry predominates, intended for students who expect to become chemists rather than chemical engineers, one in which physics including electricity predominates, for those who intend to continue advanced work in this subject, and one called the course in art, science and business administration. This change has been made in order to meet the needs of many students, who, in order to obtain a more general education than is obtainable in a four-year course in an engineering school, takes an academic course in a college or university followed by two years in an engineering school, and also to supply the need, now to be found in most engineering schools, for a greater amount of training in business administration and practice in public speaking.

The course in arts, science and business administration was inaugurated for three reasons. First, to give a liberal education, in which the sciences predominate, to those who do not intend to become professional men. Second, to give the same kind of an education to those who expect afterward to attend professional schools. A graduate from this course will be accepted by any law or medical school and he may enter the junior year of the engineering courses at R.P.I. thus obtaining the liberal education, with some business training, and the engineering education, after six years of study. The third object was to provide a five-year course of combined engineering and business subjects in which the business subjects of the new course, which are concentrated in the senior year, may be taken by an engineering student either at the end of his second year or after he has been graduated.

The curriculum of the course in arts, science and business administration includes, pure mathematics through the calculus, English including composition and literature, modern language, either French, German or Spanish, much history including that of civilization, of science and of industry, astronomy, biology, botany, geology, mineralogy, psychology, sociology, civics, economics and finance, business reports and letters, business statistics, accounting, industrial management, public speaking, hygiene and physical training. Professor Ray Palmer Baker, who is responsible for the development of this course is to be head of the new department.

In the establishment of this new course the director states that: "the institute, in no way, has departed either from its customs or its ideals as a school of science and engineering. In no sense has any attempt been made to create a university. The new course is a scientific one intended to give a liberal education in accordance with modern ideas. The four year engineering courses still form the backbone of the school and will continue to do so."

Engineering Fifty Years Ago

From *Engineering News*, August, 1875

Our Public Works

ADVANCE sheets of the 14th Annual Report of the Board of Public Works of Chicago, have been published. The principal items of interest refer to the water supply, sewerage, streets and public parks.

From the report of the board, it now appears that at the time of the 1871 fire we had 272 miles of water pipe; now we have nearly 400. There were then 1,552 hydrants; now there are 2,607. The capacity of the water works at that time was 38,000,000 gallons per day; before the close of the present financial year, it will be 100,000,000 gallons! In addition to this total increase in the quantity of water, many of the old pipes and hydrants have been replaced by new ones, and ten large fire-cisterns have been built. The report states that as soon as the new engines shall be in working order (two compound, condensing, beam-pumping engines, capable of raising 30,000,000 gallons 155 feet high in twenty-four hours), namely, in November of this year, "Chicago will be one of the safest cities in this country—if not in the world—so far as the water supply is concerned."

Philadelphia Station Agreement Before Service Commission

The Public Service Commission of Pennsylvania held a hearing on Aug. 19 concerning the agreement between the Pennsylvania Railroad Co. and the city of Philadelphia for the erection of a new railroad terminal in West Philadelphia and changes in the present Market St. station area to provide an underground suburban station. The agreement between the city and the railroad company has been executed and now requires the approval of the Public Service Commission before the work can be undertaken.

Alaska Road Construction to Be Pushed

Trails and Minor Roads To Be Built To Open as Much Territory As Is Possible

Mileage, rather than quality, will continue to characterize the Alaskan road policy of the Corps of Engineers. An announcement to the foregoing effect was made by Maj. Gen. Harry Taylor, the Chief of Engineers, on his return to Washington from a trip to Alaska. While roads will be maintained in a serviceable condition, Gen. Taylor is convinced that the public interest will be served best by extending the system of roads and trails as much as possible.

While in Alaska, Gen. Taylor personally inspected more than 1,000 miles of Alaskan roads and trails. He discussed the road question with the people in the interior, as well as with those in the centers of population and found opinion almost unanimously in favor of spreading the road appropriation over the greatest possible mileage.

While some impatience has been manifested because of the delay in developing roads, Gen. Taylor believes the cost of speeding up automobile road construction is not justified. The policy being followed is to open a trail first or to do enough clearing for thawing the first year and develop the road progressively. This frequently means that it cannot be used by automobiles until the fourth year, but this method is very economical. To push construction faster means much higher costs per mile. Even on the main roads, it has been the policy to avoid expensive surfacing. The Richardson highway, for instance, between Fairbanks and Valdez, has cost less than $10,000 for both its construction and its maintenance for twenty years.

At Wrangell Narrows, Gen. Taylor looked over the channel that the Corps of Engineers is to improve. In addition to the removal of a bar, considerable submerged rock must come out.

There is demand at several of the smaller ports in Alaska for breakwater work sufficient to afford some protection to fishing fleets during storms. Gen. Taylor visited several such points and is impressed with the need for such improvement.

Work Starts on Bridge from Buffalo to Fort Erie, Ont.

Construction work on the international highway bridge over the Niagara River between Buffalo, N. Y., and Fort Erie, Ont., was begun on Aug. 17. Contract for the substructure was let some time ago, but work was not undertaken pending the approval of the International Joint Commission.

Minnesota Federation Meets at Winnipeg

Canadians Invite American Engineers and Architects to Hold Summer Meeting in Manitoba

Staff Correspondence

For the first time in history Aug. 20 and 21, a large group of engineering societies in the North Central States and provinces of Canada held a joint meeting. Winnipeg and Manitoba, with seven organizations were the host to the nine societies comprising the Minnesota Federation of Architectural and Engineering Societies, also the State Societies of Iowa and the Dakotas. For several years the Federation has been holding summer automobile outings planned largely on the social basis with short sessions given up to technical activities of broad general interest plus welfare of the profession. Since the mud links in the highway from the Twin Cities to Winnipeg through the Red River Valley are well along toward elimination, B. W. Sewall, district highway engineer at Crookston, Minn., and the enterprising Mayor of Winnipeg, R. H. Webb, planned bringing the States engineers to investigate the resources and achievements north of the line. Winnipeg is just entering a new era of prosperity and making every effort to market her low-cost hydro-electric power and other natural resources. The mayor felt that educating the engineers of the States was well worth while. Like most summer sessions the technical program was cut to the limit giving all but one afternoon to inspection, excursions and social intercourse. One whole day the engineers were the guests of the City of the Winnipeg Hydroelectric System, a special tram being chartered to carry the 300 people to Point du Bois, 77 miles to the east of the city on the Winnipeg River, where 77,000 hp. is generated with another 14,000-hp. unit nearly completed.

Points developed by the program included the proposal of F. H. Martin, consulting engineer, Winnipeg, to export a large block of power into the States where steam standby service is already available making use of the three or four million horsepower available on the Nelson River, the outlet of Lake Winnipeg whose drainage area is 550,000 sq.mi., some 200,000 more than that of the great Lakes above Niagara Falls. Reasons for the low cost of power in Winnipeg (household rates are 3c. for lighting and 1c. for the 14,000 ranges) brought out by vigorous discussion were the high load factor of 65 per cent, and high use of 800 kw. per capita against ordinary 300 kw. in the states and low initial cost of $45 per horsepower. Mr. Martin stated that steps toward a co-operative arrangement with the competing company is being taken whereby the city would confine its activities within its boundaries and the company take over the suburban business.

C. H. Attwood, chief of Water Powers Branch, Dominion Department of Public Works, and chairman of the Winnipeg Branch of Engineering Institute of Canada, welcomed the delegates to Canada and made a strong plea for a more definite international organization including a larger group, say Wisconsin, Michigan and Ontario.

W. T. Ryan, president of the Federation described the organization, purpose and a list of twenty-two activities under way or results obtained in the five years existence of the Federation. The best work has been of a public or professional welfare nature such as enactment of a registration law, industrial lighting code for the state, establishment of a state highway testing laboratory, adoption of the National Electric Safety Code for electrical construction, and highway lighting.

W. H. Hoyt, chief engineer, Duluth, Missabe, and Northern Ry. Co. spoke similarly of the American Engineering Council.

J. T. Ellison, chief engineer, Minnesota State Highway Department, presented a picture of the present system with its 3,298 miles of graded roads; 3,100 graveled; 497 paved; and 13,655 ft. of bridges and its maintenance organization of 16 superintendents and 2,000 patrolmen handling 7,000 miles of state trunks.

George H. Herrold, director of city planning St. Paul, outlined the situation in his city. One of his trenchant remarks was the unfortunate condition of most cities where the engineers have the knowledge without power and the politicians have power without knowledge. He said some sane things about proper apportionment of street area to block use and deplored the present tendency to make all streets wider thereby increasing home land values to such an extent, business use becomes imperative and zoning fails.

E. V. Willard, Minnesota commissioner of drainage and water, briefly handled the highly controversial question of boundary waters, referring only to the conflict between utility and aesthetic use of the Lake of the Woods brought about by necessity and desirability of outlet control.

Besides entertainment at the Point du Bois hydro plant there was an inspection of the repairs to the dam spillway which has developed horizontal leaks along a construction joint. It was entirely unwatered behind a heavy coffer dam and being reinforced by an upstream triangular prism of concrete with a face having a 30-deg. slope to deflect ice over the crest. The prism is being anchored to bed rock by 1¼-in. rods set in 8-ft. drilled holes.

Invitations from Duluth for a second North Central gathering next year have been accepted informally. The participating Manitoba and Winnipeg organizations are as follows: Engineering Institute of Canada, Winnipeg Branch; Canadian Institute of Mining and Metallurgy; Association of Professional Engineers of Manitoba; Manitoba Electrical Association, Manitoba Land Surveyors, and the Manitoba Association of Architects (membership automatically puts the architect in the Royal Architects Institute of Canada).

After buying a fur coat for the real engineer of the family or a scarlet "4-point" Hudson's Bay Co. all-wool blanket or an automobile robe and settled satisfactorily with the U. S. Customs officers most of the 150 States engineers and their friends are marked for life as Canadian, and especially Winnipeg enthusiasts which after all was the real reason why Ralph Webb and Barney Sewall, as they got to calling each other, promoted the international professional idea.

Boom Knocks Down Frame of Pier Headhouse

The boom of an erection derrick knocked down an inside corner column of one half of the headhouse of Pier No. 2 North River, New York City, on August 19, 1925, and the entire steel frame, then under erection, was pulled down in the collapse. The section which fell is about 40 x 120 feet in plan and is in six bays. The transverse section of each bay is a built up column, carrying a plate girder supported first floor and an inclined trussed roof. Erection of the headhouse had been practically completed but the columns were not yet all anchored to the concrete pier footings and the steel work was only temporarily bolted preparatory to riveting, but no rivets had been driven. Such anchors as were evident after the collapse were 1 in. x 12 in. anchor bolts which had pulled clean from the concrete when the columns went over in the house-of-cards like collapse. No one was seriously injured in the accident.

The shed on Pier No. 2 is being built by the O'Day Construction Company under contract for the Department of Docks, City of New York.

Hudson River Bridge Surveys Begun by Port Authority

Engineers of the Port of New York Authority have begun making preliminary surveys for a bridge across the Hudson River at New York. The Manhatttan end of the bridge is to be somewhere between 170th and 185th St. and the highlands on each side of the river as well as the lowlands along the river shore are to be studied to obtain the best location to use in preparing preliminary bridge plans.

Road Builders Invited to Quebec

In connection with its convention to be held at Quebec, Sept. 22, 23 and 24, the Canadian Good Roads Association has extended to the executive committee of the American Road Builders' Association an invitation to meet in Quebec and attend the convention as guest of the Canadian organization. Representatives of the Road Board of Great Britain will be present and the practices in highway construction, both in America and the British Isles, will be brought before the convention.

Leakage Under Earth Dam is Under Investigation

The Horse Springs Coulee Dam of the Whitestone Irrigation Project in eastern Washington, about 15-mi. south of the international boundary, was built about a year ago but the reservoir has never been filled because of excessive leakage under the dam. Because the state had contracted to buy the bonds of the district, state authorities are now making an investigation and it is expected that an engineering report with recommendations will be forthcoming soon.

The structure is an earth dam 65 ft. high at the highest point and 700 ft. long on the crest. Water is brought to the reservoir by a wood flume from another drainage basin. Test pits and borings made prior to construction showed the dam site to be underlaid by gravel and other pervious material but it was not believed that leakage under the structure would be serious or that if more water came through than would be safe that sealing above the dam would stop it. When storage was first attempted, however, a depth of 17 ft. behind the dam produced a leakage under the structure amounting to 32 sec.-ft. and it was then realized that the reservoir could not be used until some provision had been made for cutting off this flow.

Wolman to Lecture at Harvard

Abel Wolman, chief of the Bureau of Sanitary Engineering of the Maryland State Board of Health, has accepted an invitation to deliver next autumn the course of lectures on sanitary engineering at the Harvard Engineering School and School of Public Health formerly given by the late Prof. George C. Whipple. He had been granted several months' leave of absence from his state work in Baltimore but will continue his lectures before the Johns Hopkins School of Hygiene and Public Health and also his editorship of the *Journal* of the American Water Works Association.

Chicago Engineers Inspect Large Activated Sludge Plant

Members (175) of the Western Society of Engineers, Aug. 15, on one of its summer excursions inspected the new $13,500,000 North Side sewage treatment work of the Sanitary District of Chicago. This plant, which is now about half completed and will be put in operation in 1927, will care for 175 m.g.d. of sewage from 800,000 people, including the area north of Fullerton Ave., in Chicago, Evanston, and North Shore suburbs.

Fourteen miles of intercepters 2¼ to 15 ft. in diameter and costing $11,000,000, will bring the sewage to the plant. The plant consists of a main pumping station housing three 100-sec.-ft. and two 150-sec.-ft. motor-driven centrifugals and three 30,000-cu.ft. and four 40,000-cu.ft. blowers; twelve grit chambers providing for a velocity of 1 ft. per second; eight preliminary settling tanks providing a detention period of 30 minutes; three batteries of aerators, each containing twelve aeration tanks 420 ft. long, 34¾ ft. wide and 15 ft. water depth and ten clarifiers; a main 4-story building for offices, laboratories, meters, four 30-m.g.d. sludge return pumps and two 14-m.g.d. waste sludge pumps discharging under 180-ft. head through a 14-in. 18-mile cast-iron force main to the south of the city.

Progress is fully up to schedule. Concrete for the tanks has been poured. The porous plates for air diffusion are on the ground ready for setting. Most of the clarifiers are in place. The 6½-ft. north intercepter has been built and the one to the south will be completed early next year. The long sludge discharge pipe is yet to be built as are the preliminary settling tanks, power house, blower house, pumping station and the head house.

War Department Not to Dredge Chicago Sewage Sludge

Modifications of the existing projects for improving the Chicago river and harbor are proposed by the War Department. Maintenance work on the old inner breakwaters is to be dropped, as they now serve only to protect a yacht harbor which is not needed, and eventually these structures will be removed. Dredging in the north branch of the river is to be dropped for the reason that most of the dredging required is occasioned by large deposits of sewage sludge, for which the city is responsible, and the notice of the proposed action remarks that no obligation appears to rest on the United States to maintain channel depths which are impaired by operations of the local community.

Details of Collapsed Water Tower at New York

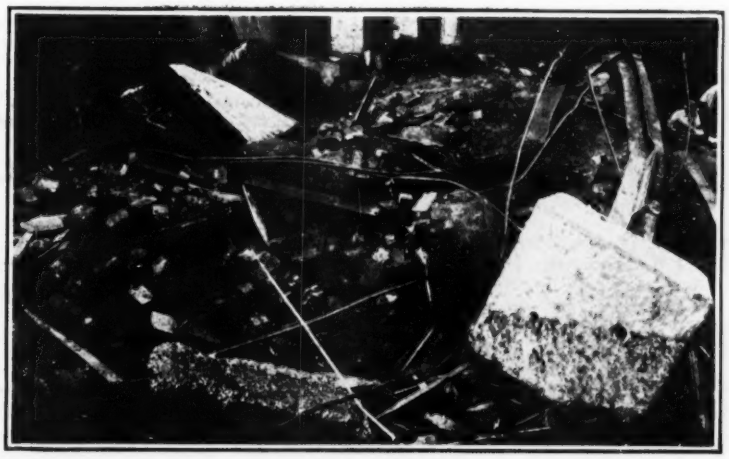


FIG. 1—SOUTHWEST LEG OF STEEL TOWER

Two lower bays of leg are visible; upper end of leg in upper-left-hand corner. Rod at left in Fig. 2 was attached to the leg at connection shown in upper left in this photo.

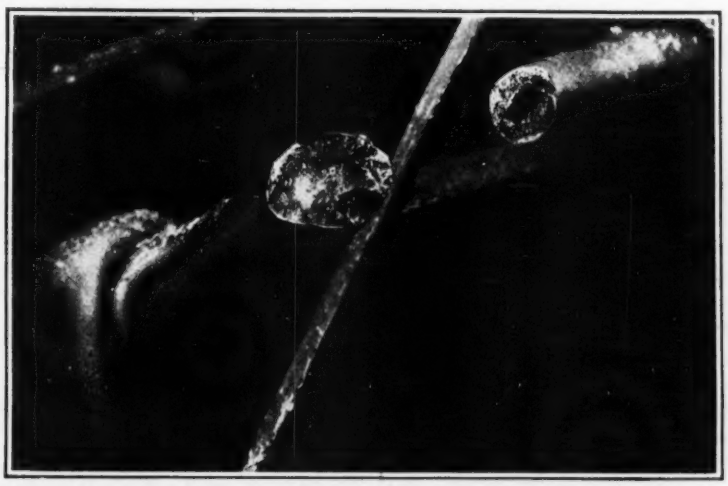


FIG. 2—TENSION ROD BROKEN AT WELD

Rod at left is broken at the weld and apparently had been broken for some time, as referred to in *Engineering News-Record*, Aug. 20, p. 321. Rod at right is end of another tension rod. At least one other rod of the bracing showed an unwelded core like that of rod at left, and an old break around a large part of the rim.

Right to Change Highway Routes Questioned

Taxpayers Bring Suit To Compel the Construction of Highways on Original Routes

A mandamus suit against the Illinois State Department of Public Works and Buildings was filed in the Circuit Court at Springfield, Ill., Aug. 20, to compel the department to construct a hard surfaced road from Sparta to Pinckneyville, Ill., over the route as originally projected. The petition alleges that the department laid out a new route that is 12 miles longer than the original route and will add $500,000 to the cost of construction.

A somewhat similar situation has arisen in Missouri where land owners in Callaway County have obtained a temporary injunction against the Missouri Highway Commission to restrain the commission from changing the route of the Kansas City-St. Louis highway from a point 4 miles west of Columbia in Boone County to a point 7 miles east of Fulton, Callaway County. The complainants allege that the highway commission located the road contrary to the designated route fixed by the State Legislature in 1919 and in doing so acted contrary to existing statutes. The highway commission claims that it is authorized by law to designate the routes of main highways. Work on two other highways which connect with the Kansas City-St. Louis cross-state highway in the section affected by the injunction is also held up.

Boring at Bridge River Dam Site in British Columbia

Diamond drill borings are being made by the British Columbia Electric Railway Co. at the dam site of the proposed Bridge River hydro-electric project located about 125 miles from Vancouver. The borings cannot be satisfactorily completed, it is reported, until after the expiration of the option which the British Columbia Electric Co. holds on this project, and it is understood that the option is to be renewed.

This option was secured from owners of water rights on the Bridge River in order that studies might be made to compare the advantages of this development with that of the proposed Ruskin plant some 3 miles below the existing plant of the company on Stave River. One of these two projects is believed to be the next logical addition to the company's system.

Gaby Temporary Head of Ontario Power Commission

F. A. Gaby, chief engineer of the Ontario Hydro-Electric Power Commission, has been appointed temporarily a member of the commission pending the appointment of a permanent successor to the late Sir Adam Beck. Mr. Gaby's appointment was made in order to enable him to direct the work of the commission until the new chairman is appointed.

Random Lines

A Losing Fight

Fourteen years ago one of the editors of this journal wrote, and had printed in *Engineering News*, the following "anonymous" letter:

> "A purposeful and apparently scientific article recently printed made a statement evincing more hope and courage than acurate truthfulness: 'We have conquered the mosquito; now let us conquer the fly.'
>
> The first part of that sentence ought to have a leading place in every newspaper, with flaring headlines. It is news par excellence; who has known heretofore that "we have conquered the mosquito"?
>
> "By the limited experience of the writer, Perry's famous dispatch seems better suited, 'We have met the enemy and they are ours.' For not only have we met them but we still meet them daily. And they are ours; that is, they are our daily and nightly house companions; we give them food as well as shelter.
>
> "It is true, literally, that we have conquered the mosquito. The writer conquers an average of one every two minutes at this season. He hears tales that the genius of Col. Gorgas has actually conquered the Panama mosquitos. Would that we had the Colonel in New Jersey—with Uncle Sam's millions to back him!
>
> "It is heroic of course to see victory far in advance, and proclaim it from the house tops. Active members of boxing clubs are known to say before the handshake, 'I've got him licked.' It is the same with the boast: 'we have conquered the mosquito.' Scientists, campaigns of extermination, entomology treaties and other weapons have been put into the arena against the mosquito, and the dreamer of visions, fired with the spirit, says 'We have conquered the mosquito.' But we keep on slapping just the same.
>
> "This is not engineering; and may not deserve a place in *Engineering News*, but it concerns a good many engineers; and some headlights of the profession have won fame as mosquito exterminators. Oh, that they would all live up to their fame and really conquer the mosquitos—or at least tell us why their efforts have come to naught."

Fourteen years of scientific effort have not mitigated the severity of these charges. The mosquito is still with us—and there are those who are beginning to wonder whether possibly the elaborate entomological explanations of his habits and background are not just so much bunk. When the hills of New Jersey and the arid wastes of Manhattan are mosquitoless we are told that our campaign against him are winning out, but when for no reason discoverable he suddenly descends upon us in hordes and swarms, we are exhorted once more to oil and drain. One community has swamps and hidden puddles and moisty roof eaves to its hearts' content—and no mosquitoes. Another patrols the byways with blotters and sponges until even dampness in non-existent and spends its tortured nights in slapping.

Far be it from us to question any expert, but the fads are getting too much for us. We believe the mosquito cometh and goeth where and when he listeth and no man knows the reason therefor.

Broad St. Subway, Philadelphia, All Under Contract

Two contracts covering construction of the portion of the Broad St. subway, Philadelphia, Pa., extending north from Courtland St. to the terminal yards at Marvine St., were awarded on Aug. 19 by the Department of City Transit to Patrick McGovern, Inc., of New York. With the award of these contracts, the entire length of the Broad St. subway from City Hall north to the terminal yards is put under contract. The amount of the contract is $11,498,032. The bids were as follows:

The Arundel Corporation	$14,113,810
Frederick L. Cranford and Locher & Co., Inc.	13,833,240
Booth & Flinn, Inc.	13,324,100
Rodgers & Hagerty, Inc.	13,080,030
Patrick McGovern, Inc.	11,498,032

The work was divided into two contracts to meet existing financial conditions. About $8,000,000 is available at the present time for subway construction and an additional $18,000 000 is provided in a bond issue which is to be voted on Sept. 15. Work on the northern section will begin at once and is to be ready for track laying by March 1, 1927, and work on the second section is to begin upon notice from the director of city transit and to be completed within two years of that date.

Changes in the Engineering Department of Los Angeles

H. A. Van Norman, recently appointed city engineer of Los Angeles, has been recalled from that position to be assistant general manager of the Los Angeles Water Department where he will be given broader responsibilities than he held previously in order to allow William Mulholland, chief engineer and general manager of the department, to devote more time to the proposed Colorado River water supply project. Mr. Van Norman has been connected with the Water Department for more than 20 years and held a responsible position in the construction of the Los Angeles aqueduct. He was "loaned" to the city for the construction of the new outfall sewer and upon its completion was appointed city engineer.

The Board of Public Works has appointed John C. Shaw city engineer to succeed Mr. Van Norman. Mr. Shaw for several months last year was acting harbor engineer for the city of Los Angeles and more recently has been engineering head of the Los Angeles office of the McClintic-Marshall Co.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER-WORKS ASSOCIATION, Boston, Mass.; Annual Convention in connection with trip on St. Lawrence River, Sept. 8-11, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

The San Francisco Section of the American Society of Civil Engineers at the regular bimonthly meeting on Aug. 18 passed three resolutions, one urging an improvement in the method of nominating officers for the parent society; a second authorizing the appointment by the president of the section of a committee to investigate and report on the present situation as to tests and inspection of construction materials and methods in San Francisco, especially in the use of concrete and steel, for the purpose of throwing light on unsatisfactory conditions; and a third resolution urging that F. E. Bonner be appointed executive secretary of the Federal Power Commission to succeed O. C. Merrill. Three short papers were presented as follows: Replacing Coos Bay Bridge Span, by George W. Rear, bridge engineer, Southern Pacific Ry.; Repairing Gem Lake Multiple Arch Dam, by Walter L. Huber, consulting engineer; Repairing Columns in First Story of a 10-Story Building in Stockton, by W. H. Alderson, structural engineer.

The North Carolina Section, American Society of Civil Engineers, at a meeting held at Asheville, N. C., Aug. 11, voted favorably upon a plan for the unification of all the sections of engineering societies into one state-wide body.

Personal Notes

E. B. SMITH, engineer of tests of the Division of Tests of the U. S. Bureau of Public Roads, has resigned in order to accept the position of research professor in the engineering department of Iowa State College. Mr. Smith has been with the department since 1914 and with the Bureau of Public Roads with the exception of two years, when he was with the Bureau of Soils. He has been in immediate charge of research work at the Arlington Experimental Station relating to engineering investigations on pavements and bridges.

FRANK K. DUNCAN, assistant highway engineer of Baltimore, Md., has been appointed assistant to Bernard L. Crozier, chief engineer.

JAMES H. MCKAY, formerly of Baltimore but for several years assistant engineer with the North Carolina State Highway Commission, has been appointed engineer in charge of new paving operations of the Department of Public Works, Baltimore. He will be connected with the Highways Bureau.

GEORGE E. CARR, of Marietta, Ohio, formerly division engineer, division 10, Ohio State Highway Department, has been appointed chief engineer of the Bureau of Maintenance to succeed H. J. Kirk. Mr. Carr graduated from Ohio State University in civil engineering in 1913, for some time was in charge of force account work in northern Ohio and later county surveyor of Washington County. O. W. MERRILL, formerly assistant division engineer, division 10, Ohio State Highway Department, has been appointed division engineer to succeed Mr. Carr.

H. E. FOREMAN has been appointed departmental secretary, Ohio State Highway Department. Mr. Foreman was assistant traffic engineer of the highway department and has been with the department for the past three years. He is a graduate of Ohio State University in the civil engineering department, in 1919. Director Schlesinger expects to add new duties to the position such as can be handled by a qualified highway engineer.

FRED G. SIMMONS has resigned as manager of the contractor's association of northern California and has been suceeded by E. G. LLOYD, who has been connected with the association for four years as executive secretary and as manager of the indemnity and insurance departments.

C. B. CROASDALE has been appointed acting chief engineer of the New Brunswick Department of Public Works, succeeding B. M. HILL, who resigned to enter the Canadian provincial cabinet as minister of public works.

E. J. OWENS, of St. John, New Brunswick, has been appointed chief engineer of the St. John and Quebec Ry.

R. A. THOMPSON, as president, H. G. BUTLER as vice-president, ARTHUR R. KELLEY as treasurer, and G. R. KENNY as secretary and general manager, have organized the WESTERN APPRAISAL CO., with offices in Los Angeles, and San Francisco, Calif., to handle the engineering phases of appraisals of industrial, commercial, public utility and other properties. Mr. Thompson was formerly a member of the Engineering Board of the Bureau of Valuation, Interstate Commerce Commission, and was formerly chief engineer of the railroad commissions of both California and Texas. Mr. Butler was formerly power administrator for the state of California and also was assistant chief engineer of the railroad commission of the state. Mr. Kelley has been valuation engineer of the Southern California Edison Co. and a consulting engineer in Los Angeles, also e'ectrical engineer of the Railroad Commission of California and assistant engineer of the Public Service Commission of the state of Washington. Mr. Kenny was formerly assistant engineer of the California Railroad Commission and was statistician and valuation engineer for the San Joaquin Light & Power Corporation and other companies.

Obituary

WILLIAM ROTCH, civil engineer, Boston, died Aug. 14, 1925, at his birthplace, New Bedford, Mass., at the age of 81. A graduate of Harvard and the Ecole Centrale des Arts et Manufactures of Paris, Mr. Rotch began his professional career as chief engineer of the Fall River water-works from 1874 to 1880. From 1880 to 1891 he served as consulting engineer for the Mexican Central, The Sonora R.R., the Atlantic & Pacific, the California Southern, and also a number of railroads in Ohio and Massachusetts. From 1881 to 1883 he was engineer and member of the commission which established the boundary line between Rhode Island and Massachusetts. In 1894 he was a member of the reorganization committee of the Atchison, Topeka & Santa Fé, and a director of that road till 1900. He was a director of the Mexican Central from 1880 to 1900 and had charge of the first train to run from Boston to Mexico City in 1884. At the time of his death Mr. Rotch had been a member of the American Society of Civil Engineers for fifty-two years, having been elected a member in 1873.

JAMES A. MCDONOUGH, Cincinnati, Ohio, assistant engineer of the Central Division office, U. S. Engineer Department, died Aug. 8 in Cincinnati. Mr. McDonough was well known for his work in connection with the canalization of the Ohio River and the manipulation of the dams of the system. He first entered the service of the Engineer Department in 1904 in the Wheeling, W. Va., district, transferring thereto from the Navy Department. He served in the Wheeling and Louisville districts as junior engineer until 1914 when he was promoted to assistant engineer. He was transferred to the Central Division office at Cincinnati in 1915.

JAMES BRADLEY, for many years a contractor and builder in New York City and a member of the Bradley Contracting Co. which did considerable work on New York subways and the Pennsylvania R.R. tunnels, died at New York on Aug. 20.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Asphalt Association Convention to Be Held in Detroit

The fourth annual asphalt paving conference, held under the auspices of the Asphalt Association, the national trade organization of the industry, will be held in Detroit, Oct. 21, 22 and 23. Many questions of importance to asphalt paving contractors, engineers, and material men will be discussed, according to J. E. Pennybacker, general manager of the Asphalt Association. Considerable attention will be given to surface treatment for sand-clay, gravel and macadam roads. Discussion will also be devoted to the possibility of salvaging old gravel and macadam highways by utilizing them as bases for asphalt pavement. The research department of the association has been conducting experiments with a view to determining ways and means of increasing the stability of sheet asphalt pavements. The results of this research will be fully presented to the convention.

In accordance with the association's expansion policy, a new district office has recently been opened in New Orleans. The association has also established a fully equipped paving laboratory at White Plains, N. Y.

Michigan Road Show at Grand Rapids

An exposition of road-building machinery, equipment and materials will be held in Grand Rapids, Mich., commencing Oct. 27 in connection with the annual convention of the Michigan Association of Road Commissioners and Engineers. The show will be held in the road commission buildings, where an area 80x206 ft. has been set aside. In addition to this, the streets and alleys adjoining the road commission's property are to be used for practical demonstration purposes. H. J. McKinley is manager of the exposition.

Business Notes

LINCOLN ELECTRIC CO., Cleveland, has just announced the appointment of the firm of Whitman & Brandt, Atlanta, Ga., as distributors for Lincoln motors and welders in the state of Georgia.

RAYMOND CONCRETE PILE CO., New York City, announces the following changes in its sales personnel: L. G. Finlay, formerly manager of the Cleveland office, has been transferred to the New York office where he is to assume the duties of special sales manager. Frank W. Johnson will be manager of the Cleveland office. George P. Morrill, manager of the Boston office, has been transferred to the new office now being opened in Miami, Fla.

OHIO LOCOMOTIVE CRANE CO., Bucyrus, Ohio, announces the appointment of Jesse C. Bader as western sales manager, with office at 432 Railway Exchange Building, Chicago.

INTERNATIONAL GENERAL ELECTRIC CO., Schenectady, N. Y., announces the appointment of Clark H. Minor, former vice-president of the company, to the position of president to succeed Anson W. Burchard, who has been both president and chairman of the board. Mr. Burchard will continue as chairman of the board.

LEAD-HYDRO-TITE CO., Boston, manufacturer of calking material, announces a change in its corporate name to the Hydraulic Development Co.

STOCKLAND ROAD MACHINERY CO., Minneapolis, Minn., announces the appointment of Cal Sivright as general manager of the company. For the past eight years Mr. Sivright has been treasurer of the Minneapolis Steel & Machinery Co. J. D. Frazer, vice-president of the Stockland company, retires from active management and takes up his new duties as vice-president and general manager of the Lyle Culvert & Road Machinery Co., Minneapolis.

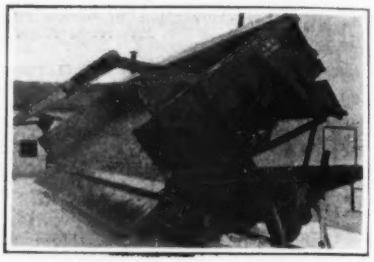
Equipment and Materials

New Air Dump Cars for Railroad and Construction Use

In order to make more efficient use of steam shovels and other loading machinery, as well as to make possible the movement of greater quantities of material with the least possible interference with traffic, the Magor Car Corp., New York City, has developed an air dump car of 30 yd. water-level capacity. The car is built throughout of steel and with the body of such dimensions as will allow of 42 yd. of material being loaded without extra top boards. Dump cars of 20 yd. and 12 yd. capacity of the same general design are also manufactured. Lifting doors that operate mechanically when the car is dumped serve to discharge the load clear of track and ballast. Extension chutes may be provided if desired. Since these chutes may be withdrawn from under the dump load, the work train is allowed to move promptly without waiting for part of the load to be hand-shoveled away from the train. The clearance between lifted door and floor is 5 ft. 2 in., which is sufficient to clear practically any load handled by a steam shovel.

The dumping cylinders are operated by air passing through special valves which are in turn operated by selective 3-way valves in each air line. These 3-way valves are located under the end platform of the car and controlled by hand rods so as to permit of complete control by the operator without risk of accident. Air may be supplied direct from the locomotive or from a steel reservoir either in the train or in individual cars.

These cars have an overall length



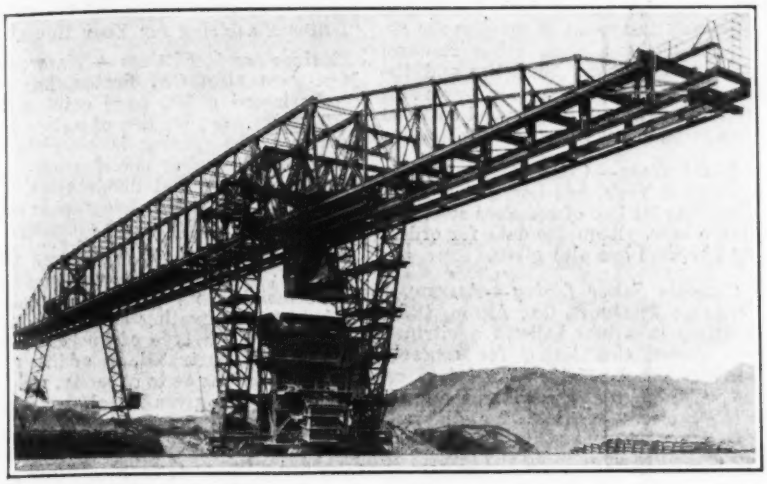
of 38 ft. 2 in. and an overall width of 10 ft. 1¾ in. Inside dimensions of the car body are 34 ft. by 8 ft. 11¼ by 2 ft. 8 in. The floor is of ⅜-in. steel plate reinforced by 2¾-in. oak planking to absorb shock. One of the new improvements consists of positive compression locks. These maintain the body in a firm position while in transit, and prevent the dumping of the body except when required. The compression lock is constructed of heavy steel castings automatically operated when the car body is released but firmly fixed when the car is in an upright position.

Separately Mounted Tractors Propel New Ore Bridge

The New York Central R.R. has recently put a new ore bridge into service at its docks at Ashtabula Harbor, Ohio, that embodies a new type of construction in its power and traction unit. The bridge is driven along the tracks by two tractors one of which is set into each leg of the bridge although they are in no manner attached to it. The pier and shear sill construction is arch-shaped with inward strut like projections against which the tractor frame abuts. There is ½ in. play between the ends of the tractor frames and the projecting struts on the bridge.

The tractors, weighing 90 tons each, have eight idler wheels and a large cast steel driving gear that meshes with a rack 1,033½ ft. long, laid between the pier and shear track rails and extending the entire length of the dock. Each tractor is equipped with two independent driving units which are coupled together by means of jaw clutches. Each driving unit is capable of driving the bridge, the second being installed only as a precautionary measure. Each unit consists of a 100 hp. motor geared to a bull pinion by means of a worm on the motor shaft and spur gears down to the bull pinion shaft. Each bull pinion weighs 4 tons.

The bull pinions being mounted on a short c. to c. tractor will more accurately mesh with the rack than is



the case in the long bridges that have the pinions mounted on the sills. Another advantage of the separate tractor mounting is that any skewing of the bridge proper will not affect the traction mechanism.

Some of the main dimensions of the installation are as follows: foundation walls, 1,080 ft. long, 287 ft. 9 in. center to center; track gage, 4 ft. 8½ in.; rail weights, 100 lb. per yd.; overall length of bridge 632 ft. 5 in.; height, trackrail to trolley rail 71 ft.; trolley travel 585 ft. 3 in. A 160 cu.ft. grab bucket is used rated at 13 tons. The bridge serves a storage capacity of about 1¼ million tons. It was fabricated by the Brown Hoisting Machinery Co., Cleveland, Ohio.

Portable Acetylene Generator for Low Pressure Welding

A small generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxweld Acetylene Co., New York. The new generator, which takes 35 lb. of carbide at one charge, can be transported readily from place to place, thus providing a portable supply of generated acetylene gas. The generator alone weighs 210 lb.

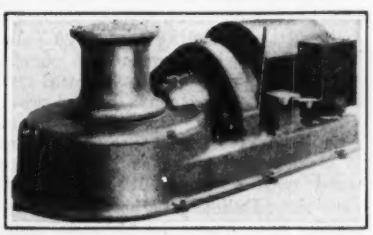
A new principle of feed control is used which might be called a "heavier-than-water" float. A vertical partition, extending nearly to the bottom into a water seal, divides the generator shell. One side is gas tight and contains the carbide hopper at the top. The upper part of the other side contains gas regulating and protective devices, and an automatic carbide feed control. Generation of the first acetylene causes water to rise on this side of the partition high enough to all but submerge a pan full of water, hung to a control lever. This pan normally functions as a weight acting counter to a spring, but as the water rises about it, its apparent weight is diminished and the carbide hopper valve is closed by the action of the spring. As acetylene is drawn off, water rises in the gas compartment and correspondingly lowers under the float, relieves some of the buoyancy under the water pan, which, gathering weight with the receding water, depresses the spring and allows a small amount of carbide to drop into the generator, and restore equilibrium conditions.

Because of its low center of gravity, the generator rights itself when tilting at an angle of 30 deg. and will work at an inclination of upwards of 10 deg. No adverse effects result if a generator is knocked over while in operation. Nearly all fittings are enclosed in the cylindrical shell and there is little projecting which may be injured by a fall on a concrete pavement. This generator has been submitted to the Underwriters' Laboratories, Inc., and has been listed by them as an acceptable device for installation on insured premises.

Electric Capstan Car Puller

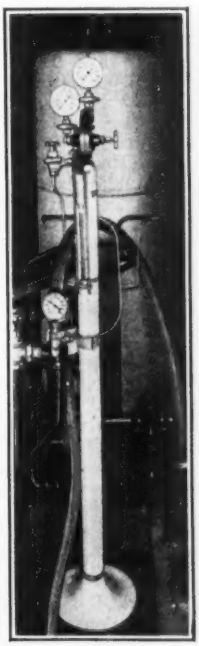
For moving and spotting cars where no switch engine is available, the Clyde Iron Works, Duluth, Minn., has recently put an electric capstan car puller on the market. The equipment consists of a vertical winch-head bolted direct to a bevel gear, driven by an electric motor through two sets of intermediate gearing and a bevel pinion. The unit is completely inclosed in a semi-steel housing so as to be dustproof and weatherproof.

All of the gears run in a bath of oil, and the Alemite greasing system is provided throughout. It is claimed that the bakelite micarta motor pinion makes operation practically noiseless. Operation is controlled by a push button arranged for foot control. Overload and low voltage protection is provided. These car pullers are built in three sizes, with 5-, 10- and 15-hp. motors developing pulls of 3,000 lb., 6,000 lb. and 10,000 lb. respectively at a line speed of approximately 40 ft. per min.



Chlorinator Has Daily Capacity of 750 Lb.

An injector type chlorinator with a capacity of 750 lb. per 24 hr. is a new product of the Paradon Engineering Co., Long Island City, N. Y. This high capacity chlorinator was originally developed for the New York City Water Department, the first installation being at the Ashokan head works on the Catskill aqueduct last winter. The illustration shows the use of this chlorinator in combination with 1-ton containers as used by the New York Water Department. The use of this large size equipment has enabled the department to simplify operations by eliminating a large number of connections and manifolds, to economize on space, and to centralize operation. The apparatus is very flexible, having a range from maximum to minimum capacity of 7½ to 1. The apparatus contains an automatic chlorine shut-off device which stops the chlorine flow when the water pressure drops below the amount required to properly operate the machine.

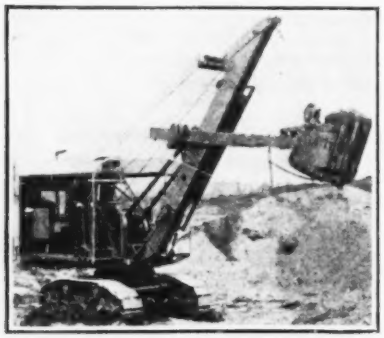


Convertible ½-Yd. Revolving Shovel-Crane

To its line of excavating equipment, the Harnischfeger Corp., Milwaukee, has recently added a ½-yd. full revolving machine, known as Model 204, that operates either as a shovel or a crane with a 30-ft. boom. It has a rated lifting capacity of 13,000 lb. at 10 ft. radius which is 75 per cent of its tipping capacity.

The power is supplied by a single gasoline motor developing 40 hp. at 960 r.p.m. although an electric motor can be supplied if desired. The two main drums are independently mounted on separate shafts and have a standard line speed of 110 ft. per min. Both the revolving frame and car body frame are of cast steel in one piece. The

corduroy frames are heavy steel castings. The treads are non-cloggable and the tread rollers are swiveled in two directions to adjust to any irregularities of the ground. All gears are well guarded to protect the operator



and the first reduction and travel gears are fully enclosed, running in oil. There are two travel speeds—1¼ and 1¾ m.p.h. either forward or reverse. The main machinery and operator's platform are fully enclosed in an all-steel cab. When equipped for shovel operation an all-steel box section boom with outside dipper sticks is used.

Publications from the Construction Industry

Arc-Welding — GENERAL ELECTRIC CO., Schenectady, N. Y., in a new 20-p. booklet, entitled "Automatic Arc Welding," gives a short history of the uses and value of automatic arc welding, together with a detailed description of the welding apparatus and the generative equipment that is necessary. Several examples of applications of the automatic arc welding process are also given, together with cost data and photographs.

Road-Building Equipment — LITTLEFORD BROS., Cincinnati, has recently published a booklet describing its line of road maintenance and construction equipment. The bulletin treats mainly of equipment for heating and applying asphalt. Descriptions are also given of gravel driers and rotary sand heaters.

Lubrication—THE TEXAS CO., New York City, in the May issue of its monthly bulletin "Lubrication," a technical publication devoted to the selection and use of lubricants, includes an article on industrial pumps and their lubrication. The article makes recommendations as to the proper lubricants to be used on the several wearing surfaces in centrifugal, rotary, and reciprocating pumps.

Water Softeners—GRAVER CORPORATION, East Chicago, Ind., has issued bulletin No. 509 dealing with water softening and water filtering. The bulletin describes the construction and operation of the Zeolite water softener for home and industrial purposes.

Wood Treatment — PROTEXOL CORP., New York City, in its bulletin No. 40, describes the use of both brush and open-tank treatment to prevent the decay of timbers when using Protexol wood preservative. Statistics and discussion are given to show how much consumers can afford to spend on wood preserving methods.

Metal Hose — CHAS. CORY & SON, INC., New York, has issued a bulletin describing its line of seamless steel and bronze hose. Requisite data for ordering purposes are also given.

Concrete Sewer Lining — AMERICAN VITRIFIED PRODUCTS CO., Akron, Ohio, describes in a new bulletin a vitrified soft glazed clay lining for concrete sewers. The booklet contains data on the construction of the lining, the number of pieces required for different diameter sewers, and instructions as to the method of relining the inverts of disintegrated and decomposed sewers. Photographs are given of several municipal installations.

Plastering—ASSOCIATED METAL LATH MANUFACTURERS, INC., Chicago, has issued three pamphlets on the general subject of plastering. The first of these, "The A-B-C of Metal Lath Erection," describes the proper erection methods of metal lath as a plaster base. The second pamphlet, entitled "The Art of Better Plastering," emphasizes the necessity for better plastering and stresses the need for fire protection. The third pamphlet describes the advantages and safety of proper plastering in home construction and is entitled "Better Plastering for Your Home."

Valves and Fittings — WALWORTH MANUFACTURING CO., Boston, has recently issued a 700 page catalog describing its complete line of valves and fittings. The catalog is complete in every detail, giving specifications, dimensions, prices and illustrations. It contains also complete telegraphic code tables and instructions for ordering.

Grab Bucket—G. H. WILLIAMS CO., Erie, Pa., has issued a new 60 p. catalog describing its line of clamshell buckets for excavating and rehandling purposes. Each type of bucket is described and illustrated, in addition to the specifications as to capacity, weight and dimensions given in tabular form.

Industrial Government — AMERICAN CAST IRON PIPE CO., Birmingham, Ala., in a 200-p. booklet, entitled "Our Job at Acipco," describes in detail its employees' ownership and industrial representation plan. The booklet is intended as an employees' manual, but is of general interest because it describes very fully a working industrial government plan.

Concrete Posts and Fountains—CHICAGO CONCRETE POST CO., Chicago, has issued a series of sheets descriptive of numerous designs of electric light posts, some of which have been used in Chicago to the aggregate extent of several thousand posts. A four-bubble drinking fountain is shown for parks and similar locations.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

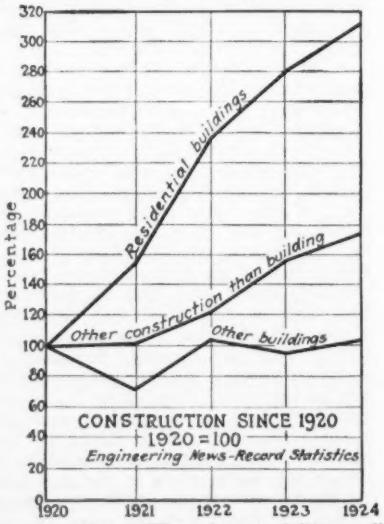
A Record Construction Year for 1925 Assured

A Drop of 8 Per Cent in Contract Value During Last Half Would Still Leave Gain of 617 Millions Over 1924

All construction contracts let in the United States in the five-year period 1920-1924 total $23,603,000,000, according to calculations by *Engineering News-Record*. This figure has been split into (1) residential contracts, (2) contracts for buildings other than residential, and (3) construction other than buildings. Fig. 1 shows the values and trend for each year.

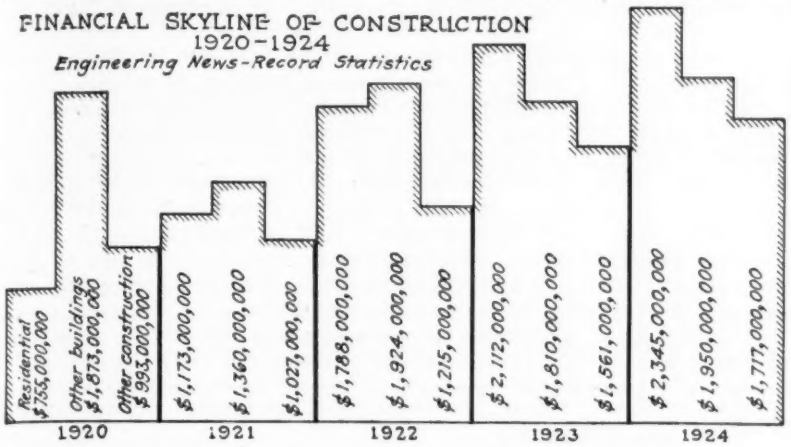
It is seen that residential building and construction other than buildings (which includes public work) are lowest in 1920. Since then, residential has become the chief division, as regards money involved, and "other construction" has nearly doubled in value.

Fig. 2 shows the relative movement of each of the three divisions. In each case the yearly contract values have been reduced to percentages of 1920 values. In this period the principal shortage was in housing. The residential curve indicates that there has been a serious effort to make up this shortage. Public works were in arrears, also, and it is this division that has gone forward with a volume second to residential. Building other than residential was heavy in 1920, as indeed was the case throughout the war period, due to unprecedented industrial



construction. The abrupt falling off in 1921 was due almost entirely to the slump in industrial building—a slump

of 74 per cent. The ratio of industrial building to other building not residential has been as follows: 19 per cent in 1913; 113 in 1919; 83 in 1920; 20 in 1921; 26 in 1922; 33 in 1923; 22 in 1924.



In terms of actual physical contract volume (not mere money value), the first half of 1925 is 16 per cent ahead of the first half of 1924. The situation may be presented thus:

	In Billions of Dollars			
	First Half		Second Half	
	1925	1924	1925	1924
Residential	$1,349	$1,267	$1,146	$1,078
Other Buildings	1,210	1,000	1,150	950
Other construction	910	880	864	837
	$3,469	$3,147	$3,160	$2,865

Contracts awarded in the first half of 1925 are $322,000,000 ahead of the corresponding period in 1924. The increase is general, although the "other buildings" division shows the greatest gain. This 10 per cent increase in money value is only a part of the true picture. Costs are lower this year than last. The construction dollar buys more materials than it did a year ago.

The figures for the second half of 1925 are of course estimated. To take a most conservative position it is arbitrarily assumed that contract-letting in the second half of 1925 will decline exactly the same percentage as in the second half of 1924.

The cost situation, as previously stated, is very favorable to the awarding of new projects. The trend has been gently downward owing to falling prices. During this period the total decline was 9.2 per cent, with no change whatever in June and July, 1925. This amounts to a comparative stabilization, which is what the industry needed most. The extraordinary volume of contracts is the response.

The labor situation, also, is in a much more satisfactory condition than in previous years. There have been fewer strikes and wage disputes.

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Aug. 27, 1925	**$41,124,000**	**$26,977,000**	**$68,101,000**
Aug. 20, 1925	28,549,000	27,981,000	56,530,000
Aug. 28, 1924	23,774,000	11,329,000	35,103,000
Heaviest Week			
1925, Aug. 13	18,556,000	56,302,000	74,858,000
1924 May 8	26,370,000	38,829,000	65,199,000
Jan. 1 to Date			
1925	715,129,000	890,625,000	1,605,754,000
1924	684,540,000	700,153,000	1,384,693,000

Referring to the chart it will be seen that there is a decided change after 1921. The heavy horizontal lines in the curve indicate relatively this change. The average per capita construction volume from 1913 to 1921 is $15.88 and for the years 1922 to 1925 (estimating the latter year) $25.53, a difference of $9.65 per capita. It is possible, of course, that the years 1921 to 1925 are merely the up-slope of a comparatively short-time curve and that that curve will return to a lower figure at some later date, but it is also possible that fashions in building and in public demand for buildings and public works may be changing and that the higher level represented in the last three years is more or less permanent. At any rate, as a matter of interest, it might be noted that to bring the construction of the earlier period—that is, 1913 to 1921—up to the present standard would require an expenditure of close to $9,000,000,000.

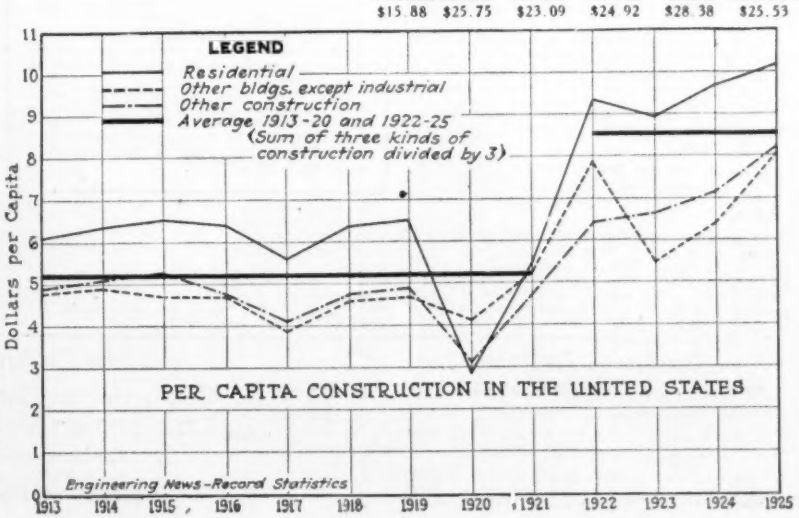
Are We On a New Plane of Construction Demand?

Many efforts have been made to estimate the construction shortage in this country. In other words, it has been generally assumed that because during the war and early post-war period considerable construction was curtailed, this deficit will have to be made up. Whether or not this is a valid assumption or whether it is a fact that the wounds of war never completely heal and that there is a lot of construction which never will be made up is a fair question. As a contribution to the consideration of the subject, however, the accompanying statistics are offered.

The table herewith gives the per capita construction in the United States, distributed through different types of construction, from 1913 to 1925 reduced to a 1913 purchasing basis. In other words, the total construction for each year has been divided by the *Engineering News-Record* cost index for the year and the resulting figure divided by the population estimated for that year. The figures in the table, leaving out industrial construction which does not affect the total, have been plotted in the accompanying curve. Industrial work does not affect the total for the reason that this class of construction more than made up any deficiency in mill capacity during the war period and therefore reached the new plane first.

PER CAPITA CONSTRUCTION IN U. S. REDUCED TO 1913 PURCHASING BASIS

	Avg. 1913 to 1921	1922	1923	1924	1925	Avg. 1922 to 1925
Residential	$5.55	$9.40	$8.89	$9.72	$10.16	$9.54
Industrial	1.12	2.13	2.14	1.68	2.04	2.00
Other buildings	4.60	7.83	5.49	6.41	8.00	6.93
Other construction	4.61	6.39	6.57	7.11	8.18	7.06
	$15.88	$25.75	$23.09	$24.92	$28.38	$25.53



Weekly Construction Market

WITH prices of basic building materials about 70 per cent and wages of common laborers 179 per cent above the 1913 level, an examination of trends in the current market reveals danger of increased construction cost lying more in the direction of labor than materials. Materials' prices have been tending downward since February of this year. Recent stiffening of wholesale prices of all commodities other than food stuffs, will probably not result in a price advance in building materials, owing to the nearness of the slower winter building period. Building trades unions, however, are reported as preparing to make demands for higher wages beginning Jan. 1, 1926. This applies particularly to the Eastern section of the country. While the common laborers' rate for the nation is 179 per cent above 1913, the proportionate advance in wages of skilled mechanics is about half that of the unskilled. The general trend of all wages is necessarily upward owing to constant introduction of improved machinery and consequent increase in commodities and demand. However, further adjustment upward of skilled building trades' wages for the coming season, at least, will be stubbornly opposed by builders and owners alike. The temporary downward tendency in the national common labor rate since December, is not due to any recession in construction demand but is traceable to the greater availability of men, following the recent curtailment of production at various mills. The current market for construction materials is characterized by firmness, with little tendency to change in the Northeastern and Western cities. Most of the fluctuation is in the South. Aside from a few adjustments in cement, steel pipe and linseed oil prices at dealers' warehouses, advances were noted during the week in c.-i. pipe, concrete aggregates, pine timbers and hollow tile. Canadian prices are stable with exception of rise in linseed oil.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	3.00	3.25	3.62½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	58%	—53.6%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	44.80	+56.00	50.20@54.20	53.00	62.00	52.00	53.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	—2.25	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	+2.20	2.38	1.90@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	+1.65	2.00	1.90@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	+2.20	2.83	1.90@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	34.00	+58.50	45.00@55.00	38.75	37.75	27.00	24.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	18.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	18.00	10.50	11.60	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	+ 0893	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1162	+ 0893	.10	.075	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	1.08	+1.15	—1.13	+1.08	+1.14	1.19	1.15	1.12	+1.25
Common Labor									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 6, the next on September 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.03). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4@4½ per cent, August 24; year ago, 2 per cent.

Time loans: short terms; 4½@4¾ per cent; longer periods, 4½@4¾ per cent.

Commercial paper: best names, 4 per cent; other names, 4¼ per cent.

On August 1, 1925

E. N.-R. Construction Cost Index Number 204.60

E. N.-R. Construction Volume Index Number 178

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month